EFFECTS OF MEMBRANE ACTION ON THE ULTIMATE STRENGTH OF REINFORCED CONCRETE SLABS

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SUMMARY

This thesis describes an investigation of the effects of membrane action on reinforced concrete slabs, particularly the implications of allowing for compressive membrane action in the design of slab and beam floors.

An examination of the minimum reinforcement requirements of a rectangular slab reveals that high design live loads are required before the benefits of membrane action can be fully exploited. Studies of the effect of compression on the flexural capacity of a reinforced concrete section and of the effect of membrane action on a clamped circular slab with elastic lateral restraint at the circumference are undertaken. These show that lightly reinforced, thick slabs with high concrete strength will benefit most from compressive membrane action in practical situations, and that if the surround is flexible, tensile membrane action will be evident at the stage when the ultimate load of the slab is reached.

The effects of compressive forces in the panels on the design of the supporting beams is studied. It is shown that some beams are required to resist considerable tension and that membrane action may have considerable effect on

the torsion induced in the edge beams. A design method is derived to deal with beams subject to tension.

An investigation is then made of the lateral restraint provided at the edges of an interior panel by the surrounding panels, considered to be of elastic, homogeneous material.

An experimental study of a quarter-scale, nine-panel slab and beam floor was conducted. The equations derived by Park for the ultimate strength of slabs with compressive membrane action were used to design the floor. The membrane action was assessed as sufficient to double the Johansen ultimate load of the centre panel. A smaller enhancement was allowed for in the centre-edge panels and none was allowed for in the corner panels. The centre spans of all beams were designed to carry the tension induced by the compressive membrane forces in the panels.

Results of fourteen load tests on this model floor are analysed with particular reference to the effects of membrane action. Satisfactory behaviour at service load was observed and the floor sustained the predicted ultimate load before failure of the centre panel. The measurement of concrete and steel strains at critical sections revealed the presence of compressive membrane forces in the centre panel and tensions in the beams that were of the order expected.

A comparison of the volumes of steel reinforcement required in the model floor indicated that design including

compressive membrane action brings no advantage except when the additional steel that is required to resist the tensile forces induced in the beams can also be used to resist moments due to earthquake or other lateral loading of the structure.

It is concluded that allowance for membrane action in design would be of small benefit for normal slab and beam floors and would be of greatest use when very high loads are imposed on slabs with high lateral restraint at the edges.

NOTATION

a, a'	Depths of the equivalent rectangular stress blocks at the ultimate flexural capacity of sections in regions of positive and negative moment respectively.
A	Gross area of a section.
A_s, A'_s	Areas of tension steel in slab or beam sections subject to positive and negative moment respectively.
b	Breadth of a rectangular section and of the web of a T- or L-section.
b_f	Breadth of flange of a T- or L-section.
c'_c	Force in concrete per unit length of a hogging moment yield line.
d, d'	Distances from the top of a section to the centroids of the tension steel, for positive and negative moments respectively.
d_n	Depth of the neutral axis of a section, measured from the compression face.
D	Overall depth of a beam or slab.
e	Strain - subscripts used are defined by Figures 7.7 and E.1.
E	Young's modulus.
f_y	Yield stress of steel reinforcement.
f'_c	Cylinder strength of concrete in compression.
f_{ct}	Tensile fracture stress of concrete.
F	Enhancement of the load capacity of a reinforced concrete slab due to membrane action, i.e., F = the ratio of the ultimate load with membrane action to that calculated by Johansen's yield line theory.

F_{max}	Maximum attainable enhancement factor for a reinforced concrete section.
F^*	Average enhancement of the moment capacities of slab sections along yield lines necessary to produce a load enhancement of F.
G	Shear modulus of concrete considered as an elastic, homogeneous material.
i_s, i_L	Ratios of hogging to sagging yield moments due to steel in the short and long directions of a slab.
i_1, i_2	Particular values of i_s and i_L.
J	Subscript denoting the value of a quantity at the Johansen ultimate load.
k_1, k_2, k_3	Constants defining the stress block for concrete in compression as proposed by Hognestad et al.(20)
L_x, L_y	Clear span plan dimensions of a rectangular slab in the x and y directions.
m, m'	Yield moment capacities, per unit length, along sagging and hogging moment yield lines respectively - taken as the moment of internal steel and concrete forces about the mid-depth of the slab.
M, M'	Moments at beam sections at mid-span and support, taken as the moment of internal actions taken about the mid-depth of the beam.
m_J, M_J	Values of m, M at the Johansen ultimate load.
M_{EQ}	Value of M due to earthquake loading only.
M_{tmax}	Maximum torsional moment in a beam.
s	Spacing of bars in slabs, or stirrups in beams.
T_x, T'_x	Tensions induced in an x-direction beam due to compressive membrane action in the panels, i.e., the difference between the steel tension and concrete forces at a beam section in the span and at a support respectively (except as used in Appendix A).
$T_1 \ldots T_6$, T_B, T'_B, T''_B	Also used to denote tension in beams.

T_m	The maximum torque in an edge beam supporting the square slab of Figure 4.4.
u	Cube strength of concrete in compression.
V	Volume of steel in a slab.
V'_u	Shear to be taken by stirrups.
w or w_M	Ultimate load per unit area of slab with membrane action.
w_J	Johansen ultimate load per unit area of slab.
W	The sum of in-plane loads acting along each half of each edge of a surround.
x, y	Rectangular co-ordinates in a horizontal plane.
δ_F, δ_S...	Vertical deflection at points F, S...
$\triangle$	Lateral deflection of slab surround.
ϵ'_x, ϵ'_y	Ratios of the effective outward movement of the edge of a surround to the half span of the slab.
λ_1, λ_2	Parameters defining the length of top steel as in Figure 2.1.
μ	(a) In Chapter 2: Ratio of the sagging yield moment, M_x, in the x-direction to that in the y-direction, M_y.
	(b) In Chapters 5 and 7 and in Appendix A: Poisson's ratio.
ϕ	Capacity reduction factor as used in ACI 318-63.

Notes:

(i) Other symbols are defined in the text, generally by Equations or Figures and apply only to one Chapter.

(ii) The notation used in Chapter 3 is defined in Figures 3.1 and 3.3 and within the text of the Chapter. Main symbols used are:

K	A measure of the flexibility of the restraining springs at the circumference.
M_r, M_θ	Moments, per unit length, in the radial and circumferential directions respectively.

M_o, M'_o	Moment capacities per unit length of sagging and hogging moment yield lines respectively when no membrane forces exist at the section.
q, q_J, q_M	Intensities of the uniform load - in general, at the Johansen load, and at the enhanced load.
Q_J, Q_M	Total loads on the circular slab.
Q_r	Shear force, per unit length, at a radius, r.
T_o	Force in the tension steel after yield.
T_θ, T_r	Net tensions, per unit length, in the circumferential and radial directions.
w	Deflection of a point on the slab.
w_o	Deflection at the centre of the slab.

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CHAPTER 1

INTRODUCTION AND SCOPE OF WORK

1.1 INTRODUCTION

In the calculation of the ultimate loads of two-way reinforced concrete slabs, the yield line theory due to Johansen[2] has been widely adopted. This theory does not include the effect of forces in the plane of the slab and under-estimates the ultimate loads of slabs when in-plane compressive forces are present because the compression enhances the ultimate moment of resistance of the section. In the common case of a lightly reinforced slab the large shift of the position of the neutral axis which occurs with cracking, causes a tendency for the edges of the slab to move outward as the slab deflects further. If the edges are restrained against outward movement, compressive forces are induced in the plane of the slab. The resulting enhancement of the load carrying capacity of the slab may be thought of as due to the enhancement of the moment capacities of the yield sections, or to an arching or doming effect in the slab as a whole.

Ockleston[3,4,5] has reported on tests on interior panels of a full scale slab and beam floor for which the

ratios of experimental ultimate load to predicted Johansen load (= enhancement factor) were greater than 2.5. The fact that Ockleston showed that this large increase could be accounted for by the development of in-plane compression has stimulated considerable research, both experimental and theoretical, into the phenomenon of membrane action in reinforced concrete slabs.

Powell[6] tested small scale rectangular slabs (36" x 20.57" x 1.286") with equal percentages of steel, top and bottom, in both directions. Experimental results revealed enhancement factors between 1.61 (for 1.53% reinforcement) to 8.25 (for .25% reinforcement).

Wood[7] tested three square panels (68" x 68" x 2.25) cast monolithically within a stiff reinforced concrete surround and obtained enhancement factors of 4.38 (for .25% reinforcement top and bottom) and 10.9 (for .25% steel on the bottom only).

In addition, Wood[7] analysed two cases of an isotropically reinforced, circular slab taking membrane action into account and assuming rigid-plastic materials. The first case was a simply supported slab with bottom reinforcement only, and the analysis gave a curve of enhancement factor versus load which rose parabolically from 1.0 at zero deflection until a central tensile membrane region started to spread outwards from the centre. The load continued to rise, almost linearly, with further

increase in central deflection as the growing tensile membrane was supported by a diminishing outer region under high compression. In the second case of a clamped circular slab, fully restrained against rotation and horizontal movement at the circumference, the assumption of rigid-plasticity gave maximum enhancement at zero deflection, with the slab in a state of maximum compression everywhere.

The enhancement at zero deflection was clearly an over-estimate of the collapse load of the corresponding real slab which deflects appreciably before full plasticity occurs. On the basis of a comparison of the maximum enhancement factor predicted by his theory with experimental values obtained in his own tests and those of Thomas[1], Ockleston and Powell, Wood proposed reduction factors to be used in assessing the practical load carrying capacities of slabs for which conditions of restraint can be relied upon to induce compressive membrane forces.

Because one possible mode of collapse of a square slab involves only the enclosed circle, Wood's analyses applied well to square (or nearly square) slabs.

Analysis of other cases of unrestrained slabs made by Morley[18], Kemp[17], Sawczuk[37], Taylor[14] and Hayes[19] have shown similar trends in slab behaviour to that of Wood's analysis of a simply supported circular slab. All analyses show that unrestrained slabs require large deflections to develop a useful degree of enhancement. The more

general case involving lateral restraint at the boundaries has more practical significance and has received considerable attention. Restrained slabs pose problems, especially in rectangular slabs with the lack of symmetry in the conditions of lateral edge restraint. The complexity of this situation has led researchers to study first the problem of a one way slab or slab strip, restrained at its ends. The related geometry of vertical deflections, neutral axis depths and outward movement of the ends forms the basis of these analyses.

Christiansen[10] related outward spread of the edges, movement of the restraining medium and elastic and plastic shortening of the slab to obtain the vertical deflection at which arching action provided greatest assistance. This theory showed good agreement with tests on four one way slabs tested by Christiansen but extension of the theory to two-way slabs was not carried out in detail.

Similar geometrical relationships were used by Liebenberg[8,9] in developing a theory for a restrained beam or slab strip, paying particular attention to the effect of the stress-strain relationship for concrete. Laboratory tests on restrained slab strips were performed to test the theory and to determine the values of empirical constants involved in it. Although favourable comparisons of theory and experiment were obtained, the empirical nature of the theory made its extension to the general case

of a two-way slab difficult.

More recently, Gurfinkel[16] has developed a computer programme to analyse simply supported beams with eccentric end restraint using the computed moment-curvature characteristic of the beam elements subject to axial compression. No experimental results were obtained to test the accuracy of the theoretical approach but the analysis is amenable to refinement and extension.

Park[11,12,13] has developed a theory for two-way slabs with membrane action to cover rectangular slabs restrained against horizontal movement and rotation along three or four edges. For the purposes of analysis the slab was envisaged as a series of strips running in both the long and short directions. The effect of outward movement of the edges and elastic creep and shrinkage strains was taken into account in relating the geometry of the deflected strips, the neutral axis depths and the magnitude of the membrane forces induced. Expressions were derived for the ultimate loads of the panels using virtual work analysis and an empirical value of central deflection at ultimate load.

Park tested 45 small scale rectangular slabs (60" x 40") in a very stiff surrounding frame. Slabs varied in thickness from 1.0" to 2.0", boundary conditions included either three or four edges laterally restrained and some tests were carried out with sustained loading.

Reinforcement ratios ranged from zero to 2.4 per cent and membrane action enhancement was considerable.

Park compared the ultimate loads of the slabs in his tests and those of Wood and Powell with very satisfactory results.

Brotchie, Jacobsen and Okubo[15] reported on tests on artificially restrained square slabs of 15" span. Thicknesses varied from 3" to $\frac{3}{4}$", bottom steel of 0, 1.0, 2.0 per cent was provided and no top steel was used. Extremely high loads were sustained due to enhancement by membrane action. In some tests, load cells were incorporated in the restraining frame and the relationship between load and membrane force was obtained. Experimental results were compared with those of a theory derived on the assumption of rigid-plastic materials using the geometry of the yield line pattern and it was concluded that the increased load capacity and the improved behaviour produced by membrane action was sufficiently large and sufficiently predictable to warrant serious consideration in design. Further studies on the practical and economic implications of membrane action were suggested.

The experimental results of Powell, Wood, Park and Brotchie, Jacobsen and Okubo have shown that very large enhancement factors can be obtained for slabs, artificially restrained, against lateral movement at the boundaries.

The results of the full scale test carried out by

Ockleston reveal that considerable enhancement of load is available in practical situations. Further evidence of this nature is to be found in the report by Liebenberg[9] on tests on 50 panels of a full scale reinforced concrete building. Panels, both interior and exterior, were tested under three- or two-point loading and enhancement of the load carrying capacity was observed in all cases. Tests on a model floor at the University of Illinois[24] revealed enhancement by membrane action. The floor as a whole failed at 547 psf with a torsional failure of the spandrel beams. The central panel alone was then loaded to failure at 829 psf, an enhancement on the Johansen load of 1.94 and it appears that if the other panels and the supporting beams had been suitably designed, the whole floor could have sustained this high load.

Thus, in the practical situations where membrane action has been observed, not all panels of the floors have been loaded simultaneously to the enhanced load and consequently the beams have not been loaded to capacity.

The aim of the work described in this thesis is to investigate the feasibility of designing panels of multi-panel slab and beam floors to allow for membrane action and to investigate the structural and economic implications of such a procedure.

1.2 OBJECT AND SCOPE OF WORK PERFORMED

As an initial part of the study of the economy

resulting from, and the feasibility of, designing slabs allowing for membrane action, the conditions leading to minimum reinforcement content in an orthotropically reinforced concrete slab without membrane action are studied. Variables studied include the coefficient of orthotropy, the ratio of hogging to sagging yield moments and the regions of load intensity for which the minimum steel requirements of codes of practice govern the amount of steel placed.

The effects of compression on the ultimate moment capacity of a singly reinforced concrete section are then examined in so far as these determine the maximum enhancement factor attainable in slabs of uniform thickness with passive edge restraint.

This study is followed by an extension of Wood's analysis of a clamped circular slab of rigid-plastic material[7]. The analysis is extended to include elastic edge restraint, unequal top and bottom reinforcement and the tensile membrane range. Results of the extended theory are compared with tests on laterally restrained square slabs.

In a multi-panel slab and beam floor when membrane action exists in the panels, tensions are induced in the beams. The effect of this beam tension on the flexural capacity of the beam is examined and a design method derived.

The presence of membrane forces normal to the edge of the supporting beams, particularly edge beams is studied with particular reference to the torsion induced in the beams.

Of particular importance in the assessment of the effects of membrane action enhancement in reinforced concrete slabs is the outward movement at the edges of the slab. For an interior panel of a multi-panel slab and beam floor, the amount of lateral movement occurring at the edges is dependent upon the stiffness of the surrounding panels with respect to in-plane forces. A surround of elastic, isotropic material is analysed using a plane stress finite element computer programme. Data on the edge movements and stresses in the surround is obtained. Because this analysis is slow, the accuracy of considering the sides of the surround as deep beams is investigated. Direct determination of the surround movement would be of great assistance in developing a theory involving the interaction of the edge forces due to panel membrane action and the outward movement of the surround.

To test the feasibility of designing floors with allowance for membrane action, Park's existing theory is used to design a nine-panel model floor. Panels are designed with allowance for compressive membrane action enhancement and the beams designed to carry the tensions induced. The behaviour of the floor as a whole, of the

centre panel, and of the beams is of particular interest in this experimental study with respect to both serviceability and ultimate strength.

Electrical resistance strain gauges were used to measure membrane forces in the panels and tensions in the beams. A study of the accuracy and sensitivity of the method used to measure these forces includes laboratory tests on control specimens.

Behaviour of the model floor is examined with particular reference to the effects of membrane action on serviceability, cracking, deflections, strain levels, the ultimate strength of the floor as a whole and the levels of membrane compression in the panels and tensions in the beams.

A comparison of the total steel volume requirements of the model floor is made between the design method used and design without allowance for membrane action. The use of steel provided in the beams for earthquake moments to resist the tension induced by membrane action is studied as part of this comparison.

Finally, general conclusions are drawn from the results of the studies made and topics for further research are discussed.

CHAPTER 2

MINIMUM STEEL REQUIREMENTS IN RECTANGULAR SLABS SUPPORTED ALONG ALL FOUR EDGES

2.1 INTRODUCTION

As a preliminary to studying the effects of membrane action on the behaviour of reinforced concrete slabs, conditions required to give the minimum steel in a rectangular slab were investigated. The following study was restricted to slabs in which top and bottom reinforcement were uniformly spaced and the ratio of hogging to sagging yield moment was equal along opposite edges. The dimensions and properties of the slab considered are shown in Figure 2.1 (a) and (b). The eight possible collapse patterns of this slab are shown in Figure 2.1(c) to (j). Patterns (c), (d), (e), and (f) all involve a central sagging yield line parallel to the L_y direction, whereas patterns (g), (h), (i), and (j) have this central yield line running parallel to the L_x direction and although the latter appear less likely to occur, they cannot be disregarded.

All patterns were considered in the following analysis in which the values of μ, i_1, i_2, λ_1, λ_2 were varied for a slab of given L_y/L_x ratio. In each case the volume of

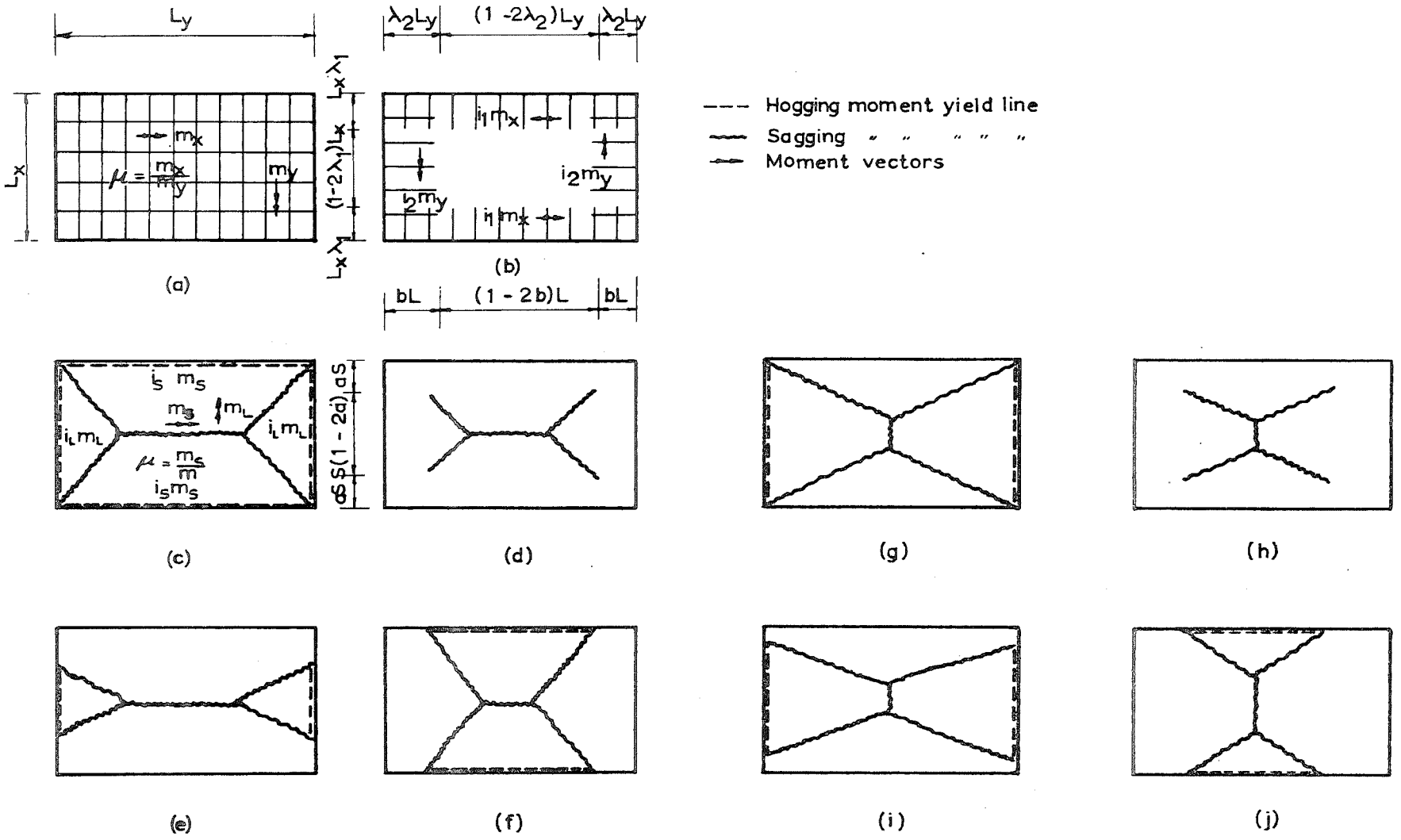


FIGURE 2.1 RECTANGULAR SLAB AND POSSIBLE FAILURE MECHANISMS

steel required for the slab was calculated and the conditions giving minimum steel volume were determined. As a result, optimum values of i_1 and i_2 were found; values of λ_1, λ_2 were related to i_1, i_2; and μ_e, the most economical coefficient of orthotropy was determined as dependent upon L_y/L_x, i_1 and i_2.

In many cases, especially when μ_e took high values, minimum reinforcement conditions were seen to govern.

2.2 VOLUME OF STEEL IN SLAB

For a lightly reinforced section, the moments per unit width are given by:

$$m_x = A_{sx}\, f_y(d_x - a/2) \qquad a = A_s\, f_y/.85\, f'_c$$

$$m_y = A_{sy}\, f_y(d_y - a/2) \qquad \ldots\ldots(2.1)$$

similar expressions resulting for the hogging yield moments. For very lightly reinforced sections the value of 'a' is small relative to d_x or d_y and for the purposes of studying minimum steel requirements it may be assumed that $d_x = d_y$.

It is therefore reasonable to assume that m_x and m_y vary directly with the area of steel, A_s, in exactly the same manner. Therefore, in general, $A_s = km$ where k is a constant incorporating d_x and f_y.

The volume of steel, V, is then given by

$$V = \underset{\text{(bottom steel)}}{k\, L_x L_y m_y (1+\mu)} + \underset{\text{(top steel)}}{2k\, L_x L_y m_y (i_1 \lambda_1/\mu + i_2 \lambda_2)} \qquad \ldots(2.2)$$

2.3 COLLAPSE MODES OF SLAB

Figures 2.1(c) and (d) show the two most probable collapse modes.

In (c) full hogging moments are developed around the edges of the slab and full sagging yield moments developed along the sagging yield lines as shown.

In (d) the portion of the panel without top reinforcement fails as a simply supported slab of reduced span lengths. Collapse patterns (e), (f), (g), (h), (i), (j) were not considered at this stage, but it will be shown that the conditions imposed by modes (c) and (d) require little or no modification when the other patterns are considered.

The collapse load of mode (c) may be shown to be [7],

$$w_c = \frac{24 m_y \mu^2 (1+i_1)}{L_x^2 \left(\frac{L_x}{L_y}\right)^2 \left[\sqrt{\frac{1+i_1}{1+i_2} + 3\mu\left(\frac{L_y}{L_x}\right)^2} - \sqrt{\frac{1+i_2}{1+i_1}}\right]^2} \quad \ldots\ldots(2.3)$$

and since mode (d) is a special case of (c) for which $i_1 = i_2 = 0$, $L_x = (1-2\lambda_1)L_x$, $L_y = (1-2\lambda_2)L_y$:

$$w_d = \frac{24 m_y \mu^2}{L_x^2 \left(\frac{L_x}{L_y}\right)^2 \frac{(1-2\lambda_1)^4}{(1-2\lambda_2)^2} \left[\sqrt{1+3\mu\frac{(1-2\lambda_2)^2 L_y^2}{(1-2\lambda_1)^2 L_x^2}} - 1\right]^2} \quad \ldots\ldots(2.4)$$

The minimum length of top steel may be obtained by equating $w_c = w_d$. The resulting relationship between i_1, i_2, λ_1

and λ_2 is

$$\frac{(1-2\lambda_1)^2}{(1-2\lambda_2)}\left[\sqrt{1+3\mu\left(\frac{L_Y}{L_X}\right)^2\frac{(1-2\lambda_2)^2}{(1-2\lambda_1)}}\;-1\right] =$$

$$\sqrt{\frac{(1+i_2)}{(1+i_1)^2}}\left[\sqrt{1+3\mu\left(\frac{L_Y}{L_X}\right)^2\frac{(1+i_1)}{(1+i_2)}}\;-1\right] \qquad \ldots.(2.5)$$

Comparison of similar terms on the left and right sides of Equation 2.5 gives:

$$\frac{(1-2\lambda_1)^2}{(1-2\lambda_2)} = \sqrt{\frac{(1+i_2)}{(1+i_1)^2}} \qquad \ldots.(2.6)$$

and $$\frac{(1-2\lambda_2)^2}{(1-2\lambda_1)} = \frac{1+i_1}{1+i_2} \qquad \ldots.(2.7)$$

Equating values for $(1-2\lambda_1)^2$ given by each of 2.6 and 2.7 gives:

$$\frac{(1-2\lambda_2)}{(1+i_1)}\sqrt{1+i_2} = \frac{(1-2\lambda_2)^2\,(1+i_2)}{(1+i_1)} \qquad \ldots.(2.8)$$

which reduces to:

$$1-2\lambda_2 = \frac{1}{\sqrt{1+i_2}} \qquad \ldots.(2.9)$$

and similarly

$$1-2\lambda_1 = \frac{1}{\sqrt{1+i_1}} \qquad \ldots.(2.10)$$

Thus λ_1 and λ_2 may be determined if i_1 and i_2 are known.

2.4 MOST ECONOMICAL COEFFICIENT OF ORTHOTROPY, μ_e

The value of μ which gives the least volume of steel in the slab may be determined by setting $\frac{\partial V}{\partial \mu} = 0$.

From Equation 2.2:

$$V = k\, L_x L_y m_y (1+\mu+2\, i_1\lambda_1\mu+2i_2\lambda_2) \qquad \ldots.(2.2a)$$

and $m_y = \dfrac{w L_x^2 \left(\frac{L_x}{L_y}\right)^2 t^2 (1-2\lambda_1)^4}{24 \quad \mu^2(1-2\lambda_2)^2}$ from Equation 2.4.

in which $t = \sqrt{1+3\mu\left(\frac{L_y}{L_x}\right)^2 \frac{(1-2\lambda_2)^2}{(1-2\lambda_1)^2}} - 1 \qquad \ldots.(2.11)$

For differentiation with respect to μ, values of i_1, i_2, L_x, L_y will be constant and therefore substitution for m_y in Equation 2.2a gives:

$$V = K\left[\frac{t^2}{\mu^2}(1+2i_2\lambda_2) + \frac{t^2}{\mu}(1+2i_1\lambda_1)\right]$$

$$\therefore \quad \frac{1}{K}\frac{\partial V}{\partial \mu} = (1+2i_2\lambda_2)\left(\frac{2t}{\mu^2}\frac{\partial t}{\partial \mu} - \frac{2t^2}{\mu^3}\right) + (1+2i_1\lambda_1)\left(\frac{2t}{\mu}\frac{\partial t}{\partial \mu} - \frac{t^2}{\mu^2}\right) \qquad \ldots.(2.12)$$

$= 0$ for minimum V.

Now from Equation 2.11:

$$t^2+2t = 3\mu\left(\frac{L_y}{L_x}\right)^2 \frac{(1-2\lambda_1)^2}{(1-2\lambda_2)^2}$$

$$\therefore \quad \frac{\partial t}{\partial \mu} = \frac{3\mu}{2(t+1)}\left(\frac{L_y}{L_x}\right)^2 \frac{(1-2\lambda_1)^2}{(1-2\lambda_2)^2}$$

Substitution for μ and $\frac{\partial t}{\partial \mu}$ in $\frac{\partial V}{\partial \mu} = 0$ gives

$$t+1 = 3\left(\frac{L_y}{L_x}\right)^2 \frac{(1+2i_2\lambda_2)}{(1+2i_1\lambda_1)}\left(\frac{1-2\lambda_1}{1-2\lambda_2}\right)^2 - 1$$

which is the condition for minimum volume.

Substituion for t+1 from Equation 2.11, squaring, and collecting terms leads to the result:

$$\mu_e = \frac{3\left(\frac{L_y}{L_x}\right)^2\left(\frac{1-2\lambda_2}{1-2\lambda_1}\right)^2 - 2\left(\frac{1+2i_1\lambda_1}{1+2i_2\lambda_2}\right)}{\left(\frac{1+2i_1\lambda_1}{1+2i_2\lambda_2}\right)^2} \quad \ldots.(2.13)$$

which corresponds to the result stated by Wood[7]. The validity of Equations 2.3 to 2.13 is limited to the range of i_1 and i_2 values for which the collapse mode is of the form shown in Figure 2.1(c). In particular, the central sagging yield line must be parallel to L_y. For the symmetrical rectangular slab under consideration, this condition is fulfilled if $\mu \geq \left(\frac{L_x}{L_y}\right)^2\left(\frac{1+i_2}{1+i_1}\right)$.

2.5 MOST ECONOMICAL VALUES OF i_1 and i_2

The values of i_1 and i_2 which give the least volume of steel could be determined by differentiation of Equation 2.2 but this is difficult and tedious and a simple computer programme was written to investigate the effects of i_1 and i_2 on the steel volume.

For each L_y/L_x ratio steel volumes were calculated for a range of i_1 and i_2. For each combination of i_1 and i_2, μ_e was calculated before the volume of steel was computed.

In all cases the combination of $i_1 = i_2 = 2.0$ gave minimum volume. For a square slab, the differentiation of

the volume expression with respect to i (= i_1 = i_2) does, in fact, give i = 2.0 for minimum steel.

For $L_y/L_x \approx 1.0$ greatest economy is thus achieved if $i_1 = i_2 = 2.0$, provided μ_e can be attained.

2.6 EFFECT OF OTHER COLLAPSE MODES

(i) Modes (c), (d), (e), and (f)

By considering modes (e) and (f) as special cases of mode (c) it may be shown that, provided λ_1 and λ_2 are calculated from Equations 2.9 and 2.10, modes (c), (d), (e), (f) have identical collapse loads for any given value of μ.

(ii) Modes (g), (h), (i), (j)

Since these bear the same relation to each other as (c), (d), (e), (f), the collapse loads of patterns (g), (h), (i), (j) are identical. It is thus necessary to find the regions of L_y/L_x, i_1 and i_2 for which the latter modes have a lower collapse load than the former. To achieve this the loads of each set were computed for a range of L_y/L_x, i_1 and i_2 (λ_1 and λ_2 were calculated using Equations 2.9 and 2.10; the coefficient of orthotropy, μ, was always set at μ_e as given by the particular values of L_y/L_x, i_1 and i_2). Under these conditions, modes (g), (h), (i), (j) governed only when L_y/L_x, i_1 and i_2 were such that mode (c) was not valid initially for the calculation of μ_e. By considering the case when the collapse pattern

consists of diagonal yield lines, it may be shown that the initial collapse mode is valid if the value of μ_e calculated therefrom (Equation 2.13) satisfies

$$\mu_e \geq \left(\frac{L_x}{L_y}\right)^2 \frac{(1+i_2)}{(1+i_1)} \qquad \ldots.(2.13a)$$

Only in exceptional cases will this condition not be satisfied since for economy $i_1 \approx i_2$ and $\mu_e \approx 3\left(\frac{L_y}{L_x}\right)^2 - 2$

i.e. μ_e, increases with L_y/L_x while its minimum allowable value decreases.

The analysis of modes (c) and (d) will therefore provide sufficient check unless Equation 2.13a is not satisfied.

2.7 PRACTICAL IMPLICATIONS AND LIMITATIONS

For a slab of chosen L_y/L_x, three parameters were investigated for a range of i_1 and i_2 values in order to assess the practical usefulness of Equation 2.13. The parameters investigated were: (i) the most economical coefficient of orthotropy; (ii) the volume of steel required in the slab; and (iii) the range of load and i values for which minimum reinforcement requirements do not govern.

(i) Variation of Most Economical Coefficient of Orthotropy

The variation of μ_e with i_1 and i_2 was determined for

a given L_y/L_x ratio by using Equation 2.13. Values of i_1 and i_2 between 0 and 3.0 were used. For each combination, λ_1 and λ_2 were determined by Equations 2.9 and 2.10 and μ_e calculated. Values of μ_e were plotted on an i_1 vs i_2 graph and contours of equal μ_e drawn in the regions where the value of i_2 did not invalidate the assumed failure mechanism.

Figure 2.2 shows these graphs for L_y/L_x = 1.0 and 2.0.

(ii) Variation of Steel Volume

In this investigation the value of μ_e was calculated and used to find the values of m_x and m_y. The value of m_y was found from Equation 2.4 and the percentage of steel, p, calculated using the equation $pd^2f_y = m$, based on the assumption that the depth of the rectangular stress block, a, is zero.

From 2.4

$$\frac{m_y}{f'_c d^2} = \frac{w\left(\frac{L_x}{d}\right)^2}{24 f'_c}\left(\frac{L_x}{L_y}\right)^2 \frac{t^2}{\mu^2} \frac{(1-2\lambda_1)^4}{(1-2\lambda_2)^2} \qquad \ldots.(2.4b)$$

in which $\frac{w\left(\frac{L_x}{d}\right)^2}{24 f'_c} = W_R$ is a convenient non-dimensional measure of the load which, for the purposes of this investigation, was kept high so that minimum reinforcement conditions were not encountered in the range of values of i and L_y/L_x investigated. From the values of percentage steel volume calculated for each combination of i_1 and i_2, contours of equal volume were plotted for valid regions on

FIGURE 2.2 VARIATION OF μ_e

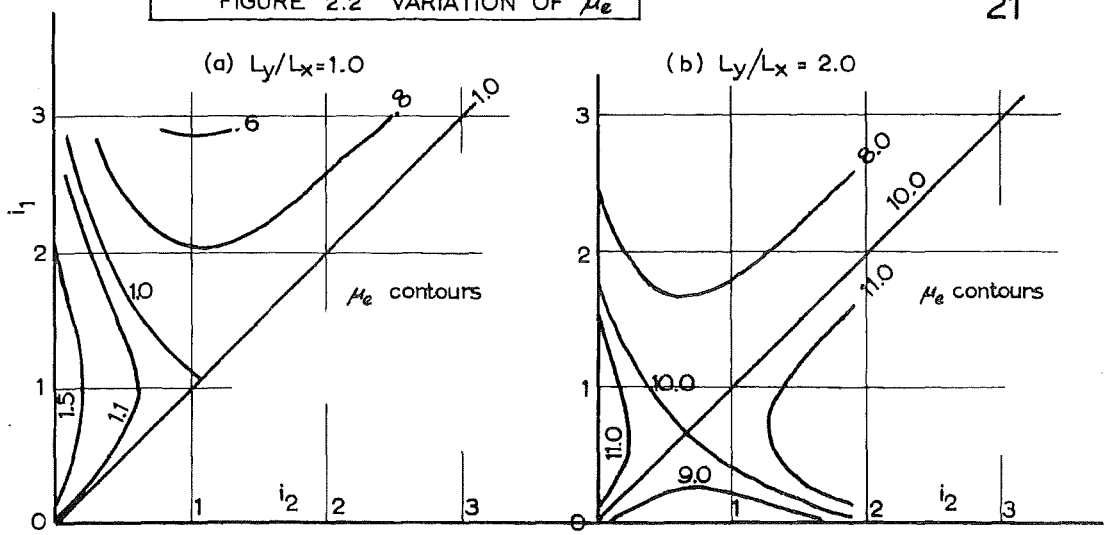


FIGURE 2.3 VARIATION OF STEEL VOLUME

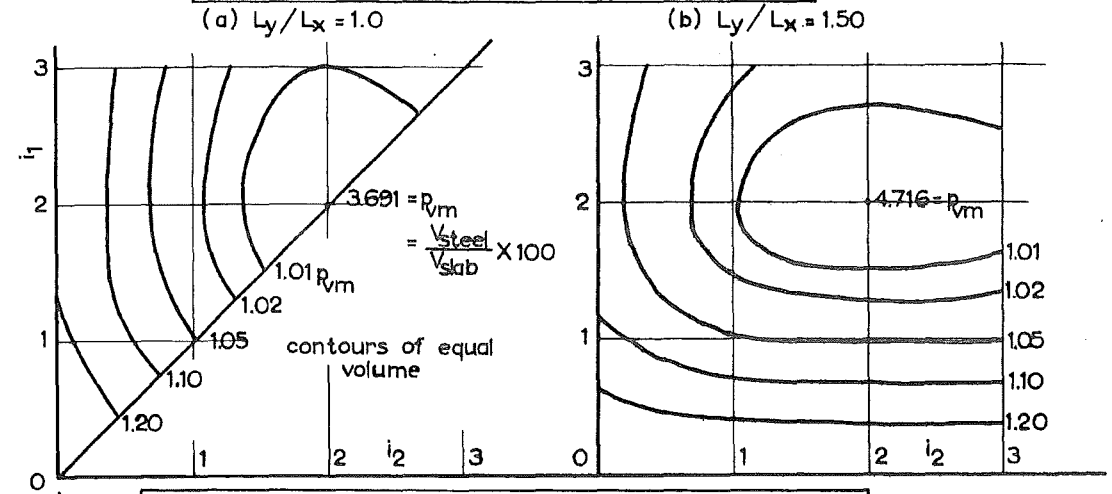
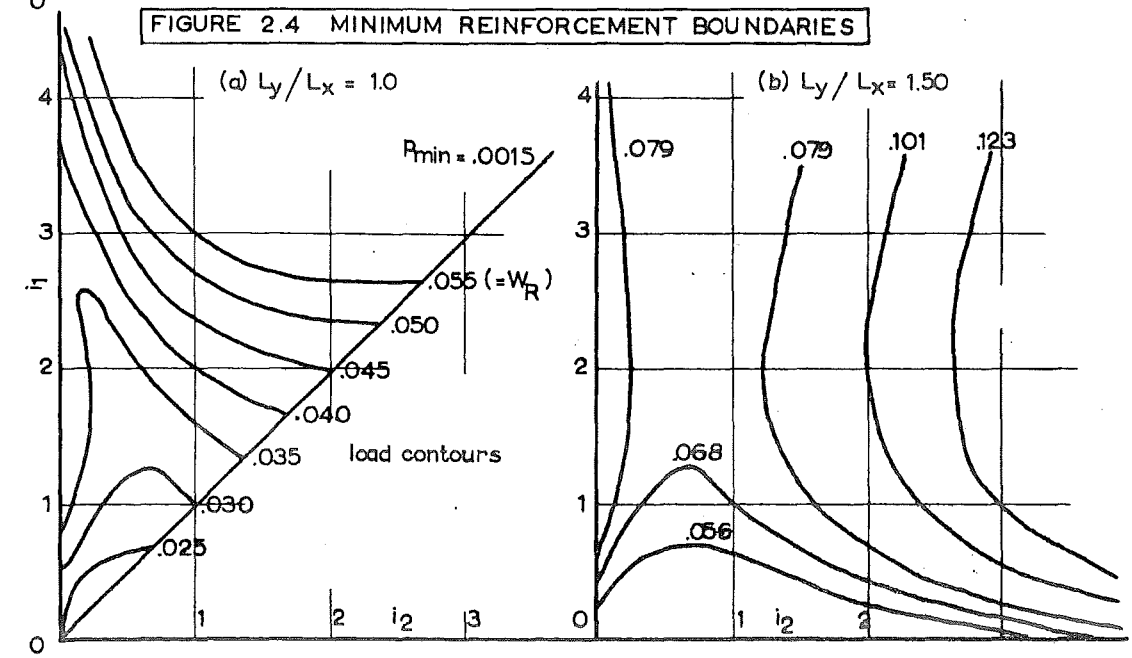


FIGURE 2.4 MINIMUM REINFORCEMENT BOUNDARIES



the i_1 vs i_2 graphs. Figure 2.3 shows these contours for L_y/L_x = 1.0 and 1.5.

(iii) Minimum Reinforcement Restriction Imposed by Codes of Practice

For each value of L_y/L_x, a range of load parameters was used, for each of which the contour on the i_1 vs i_2 diagram was found which marked the boundary beyond which minimum reinforcement restrictions would govern.

The steel percentage was calculated on the basis described in (ii) above. In all cases μ_e was calculated before m_y and p.

Figure 2.4 shows contours of equal W_R for L_y/L_x = 1.0 and 1.5. The minimum steel percentage allowed in these figures was .15 per cent as in the British Code of Practice CP114.

2.8 DISCUSSION

Figures 2.2, 2.3 and 2.4 show clearly the effect of the various parameters.

The value of μ_e is not affected greatly by change in i_1 and i_2 values particularly in relation to the effect of increase in (L_y/L_x) ratio. The large increase in μ_e with increase in L_y/L_x reduces the steel requirement in the long direction and hence far greater loads are necessary in rectangular slabs to avoid minimum reinforcement conditions

when the value of μ_e is used. To illustrate the interpretation of W_R values, consider a slab with $(L_x/d) = 30$, $f'_c = 4000$ lb/in^2. The ultimate load, w, is then $106.9W_R$ psi which for $W_R = .025$ is 2.67 psi or 374 psf. Comparison of these values with Figure 2.4 shows just how often minimum steel will govern.

When minimum reinforcement conditions do not apply, the volume of steel may be seen to vary considerably with i_1 and i_2 for a given L_y/L_x. For the very minimum conditions of $i_1 = i_2 = 2.0$, increase in L_y/L_x requires more steel per unit volume of slab. The advantages of using a value of i_1 in the region of 2.0 are clear from inspection of Figure 2.3 and, for slabs with $L_y/L_x > 1.0$, a decrease in i_2 from the position, $i_1 = i_2 = 2.0$, brings smaller penalties than a decrease in i_1. Penalties for decreasing i_2 from this point are relatively less for a slab with $L_y/L_x > 1.0$, but it is clear that use of $i_1 > i_2$ should be preferred.

It may be concluded that although minimum reinforcement conditions will govern in many cases, values of $m_x/m_y = \mu_e$ and $i_1 \approx i_2 \approx 2.0$ will give greatest economy where these conditions can be achieved. Furthermore, it is apparent that variation from this optimum does not increase the volume of steel greatly but an increase in i_2 may result in appreciable change in minimum reinforcement conditions for slabs with $L_y/L_x > 1.0$.

CHAPTER 3

A STUDY OF THE EFFECT OF MEMBRANE FORCES ON A REINFORCED CONCRETE SECTION AND ON A CIRCULAR SLAB WITH PARTIAL LATERAL RESTRAINT AT THE EDGES

3.1 ENHANCEMENT OF THE MOMENT CAPACITY OF A REINFORCED CONCRETE SECTION

3.1.1 Introduction

The enhancement of the load carrying capacity of reinforced concrete floors by compressive membrane action is due to the enhancement of the moment capacity measured about the mid-depth of the sections along the yield lines. For any singly reinforced section there is a limit to the factor by which the application of compression enhances this moment capacity. The amount of reinforcement in the section has the greatest effect on this maximum factor and in the following sections, the effect of reinforcement and other variables on the maximum attainable enhancement factor is examined.

3.1.2 Yield Locus for a Singly Reinforced Section

By examining the conditions at ultimate, on a singly reinforced section, a failure locus may be obtained

relating the moment and axial compression.

Consider the section as in Figure 3.1(a) and having a tensile stress, f_y, in the steel and a rectangular stress block for the concrete, as shown in Figure 3.1(c).

With the notation as in Figure 3.1, noting that the moment of forces is taken about the mid-depth of the section:

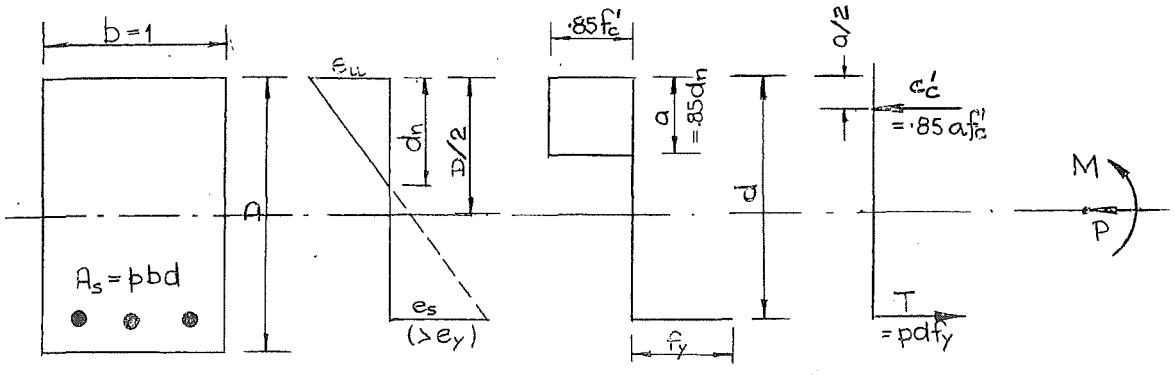


FIGURE 3.1. SECTION NOTATION.

$$P = .85f'_c.a - pdf_y \qquad ....(3.1)$$

$$M = .85\, f'_c.a.(D/2-a/2) + pdf_y\,(d-D/2) \qquad ....(3.2)$$

and if the moment about the mid-depth for P = 0 is denoted M_o, then $M_o = pdf_y(d-pdf_y/1.7f'_c))$ and $T_o = pdf_y$.

Elimination of 'a' from Equations 3.1 and 3.2 gives the yield locus as

$$M/M_o = 1+g(P/T_o)-h(P/T_o)^2 \qquad ....(3.3)$$

in which

$$g = (.5D/d-2t)/(1-t) \qquad ....(3.3a)$$

$$h = t/(1-t) \qquad ....(3.3b)$$

$$t = pf_y/(1.7\ f'_c) \qquad ....(3.3c)$$

For M/M_o to be a maximum, $\frac{dM}{dP} = 0$, which gives

$$(P/T_o) = 2g/h \qquad ....(3.4)$$

and $$F_{max} = (M/M_o)_{max} = 1+g^2/4h \qquad ....(3.5)$$

where F_{max} is the maximum attainable enhancement factor, and is a function of t and D/d only.

3.1.3 Relationship Between t, D/d and F_{max}

The relationships between F_{max}, D/d, p, and f_y/f'_c may be shown on one graph.

Considering the relationship between F_{max}, t and D/d, Equation 3.5 gives

$$F_{max} = 1+\frac{(\frac{1}{2}D/d-2t)^2}{4(1-t)t}$$

the solution for which is

$$t = \frac{[2F_{max}-(2-\frac{D}{d})] - \sqrt{[2F_{max}-(2-\frac{D}{d})]^2-F_{max}(\frac{D}{d})^2}}{4F_{max}} \qquad ...(3.6)$$

Therefore t may be plotted against F_{max} for a given D/d. From Equation 3.3(c) it is clear that 't' may also be plotted against f_y/f'_c to give a straight line of slope =

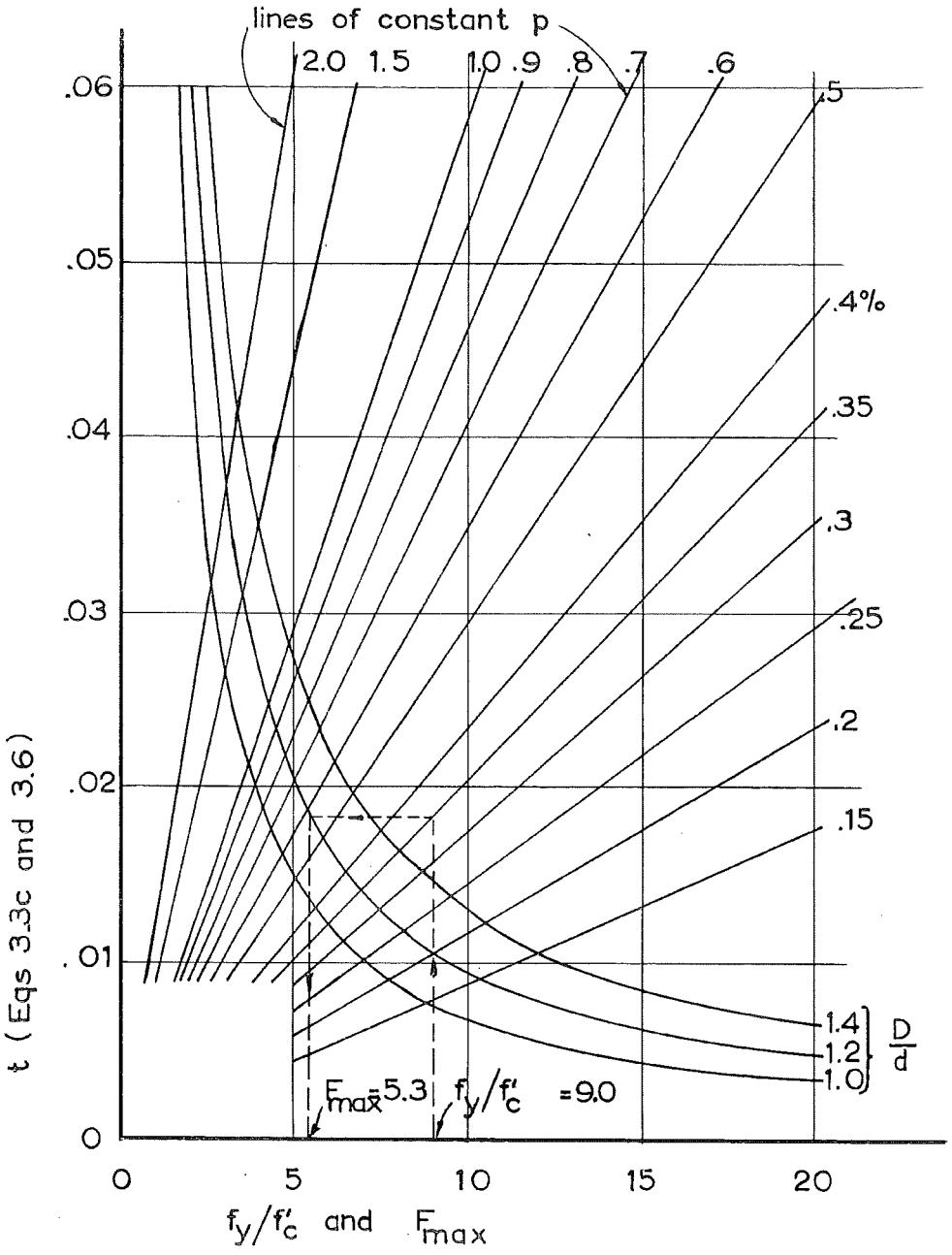


FIGURE 3.2 MAXIMUM ENHANCEMENT FACTOR

p/1.7.

The plots of f_y/f'_c and F_{max} (horizontal axis) against t (vertical axis) are shown in Figure 3.2. The maximum attainable enhancement factor for a given f_y/f'_c, D/d and p is determined by following the appropriate vertical line corresponding to f_y/f'_c until the desired straight line for p is met at an ordinate t_1. The point with ordinate t_1 on the appropriate curve of constant D/d has an abcissa equal to the maximum attainable enhancement factor. This process is shown on the figure for f_y/f'_c = 9.0, D/d = 1.20 and p = .003, to give F_{max} = 5.3.

3.1.4 Condition That Steel Will Yield at Maximum Enhancement

In the above analysis it was assumed that the steel strain, e_s, exceeded the yield strain, e_y, at all times. The situation giving least steel strain is that when maximum moment enhancement is reached. This is when the depth of the rectangular stress block, a = .5D since any increase of 'a' beyond .5D would reduce the moment about the mid-depth. When a = .5D, d_n = D/1.7 and consideration of similar triangles on the strain diagram (Figure 3.1(b)) yields

$$e_s = e_u\,(1.7(d/D)-1) \qquad \ldots.(3.7)$$

If the modulus of elasticity of the steel, E_s, = 30 x

10^6 psi, then $e_y = f_y/30 \times 10^6$ and for yield to take place $e_s > e_y$. This requires

$$30 \times 10^6 \, e_u(1.7(d/D)-1) > f_y \qquad \ldots.(3.8)$$

For $e_u = .0033$, the following conditions result if yield is to occur:

$D/d = 1.0$, $f_y \not> 70{,}000$ psi

$D/d = 1.1$, $f_y \not> 54{,}500$ psf

$D/d = 1.25$, $f_y \not> 36{,}000$ psi

Thus for most mild steels in sections with values of $D/d \not> 1.2$ the condition of $a = .5D$ does not invalidate the assumption that the tension steel is yielding.

3.1.5 Discussion and Conclusion

The variation of F_{max} with f_y/f'_c, D/d and p is summed up in Figure 3.2. Quantitative data as to the reduction of F_{max} with increase in p, the increase in F_{max} with increase in D/d, and the reduction of F_{max} with increase in f_y/f'_c may be obtained therefrom. This diagram serves also as a compact qualitative description of the factors influencing the enhancement of the moment capacity of the section. It is clear from Figure 3.2 that to obtain the highest enhancement factor, any design should aim at:

(i) A low value of f_y/f'_c, which would be best

achieved by increasing the concrete strength since it is the concrete which is providing the enhancement.

(ii) A high value of D/d gives a large enhancement factor. However, a high value of D/d would cause a reduction in stiffness and in the absolute value of the unenhanced moment, M_o. Other factors such as crack widths dictate that minimum cover to the tension steel is preferable and the D/d value would thus be fixed within close limits.

(iii) A low reinforcement content. This requirement is the most critical. The low reinforcement content of reinforced concrete slabs leads to the enhancement of their load carrying capacities due to self-induced compression on the sections when the outer edges are restrained from moving laterally outward. This greater enhancement for lower slab reinforcement is not due entirely to the fact that greater enhancement of the moment capacity of a section is available. The tendency for the edges to spread outwards as the slab deflects is greater for lightly reinforced slabs since the neutral axis is nearer the compression face of the concrete. The benefit gained from this effect is not apparent in the figure.

Finally, it must be remembered that for slabs, the attainment of the maximum available enhancement will be impossible in practice if the net compression is provided

by passive restraint against lateral movement, since the lateral movement and vertical deflection will impose the condition that $a < D/2$. However, in cases where the net compression is actively applied it is possible that 'a' may equal (or even exceed) D/2.

3.2 THE EFFECT OF MEMBRANE ACTION ON A CLAMPED CIRCULAR SLAB SUPPORTED AND LATERALLY RESTRAINED AT ITS CIRCUMFERENCE

3.2.1 Introduction and Summary

Wood[7] has dealt with the effect of membrane action on uniformly loaded circular slabs, both clamped and simply supported. Exceptionally high enhancement factors were obtained for the clamped slabs since Wood assumed that the concrete and steel were rigid-plastic materials and the lateral movement of the edges was zero. This resulted in a load-deflection curve which fell from a maximum at zero deflection. In this section the extension of Wood's treatment to include finite movement at the edges and the case of unequal top and bottom reinforcement is described. The results obtained compare well with some available test data for very stiff surrounds and the load-deflection curve exhibits an algebraic maximum.

For more flexible surrounds, the commencement of a tensile region at the centre occurred before this maximum was reached and special consideration of this case was

required.

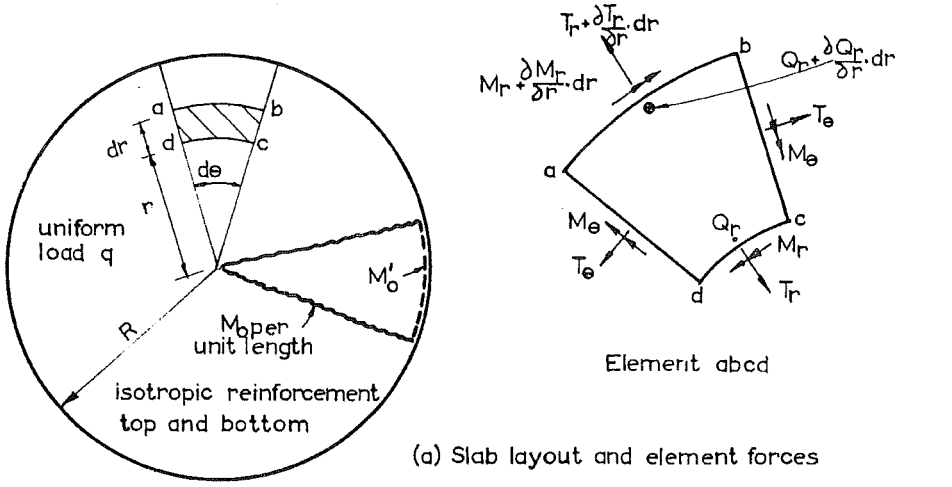
In this case it was found that the conditions at the edge of the slab could not be defined explicitly, requiring an assumption to be made regarding the relationship between the radius of the tensile membrane and the membrane force at the perimeter. This enabled a load-deflection relationship to be determined after the tensile membrane began but its validity is questionable because the assumption of rigid-plastic materials became inaccurate when the surround stiffness was low, and particularly when the tensile membrane started before a maximum load was attained.

It is pertinent to point out, before proceeding, that the conical collapse mechanism of a circular slab of radius R applies also to the case of a square slab of side 2R, and for a uniformly distributed load, the Johansen loads are identical. The results of the following analysis will therefore apply equally well to square panels.

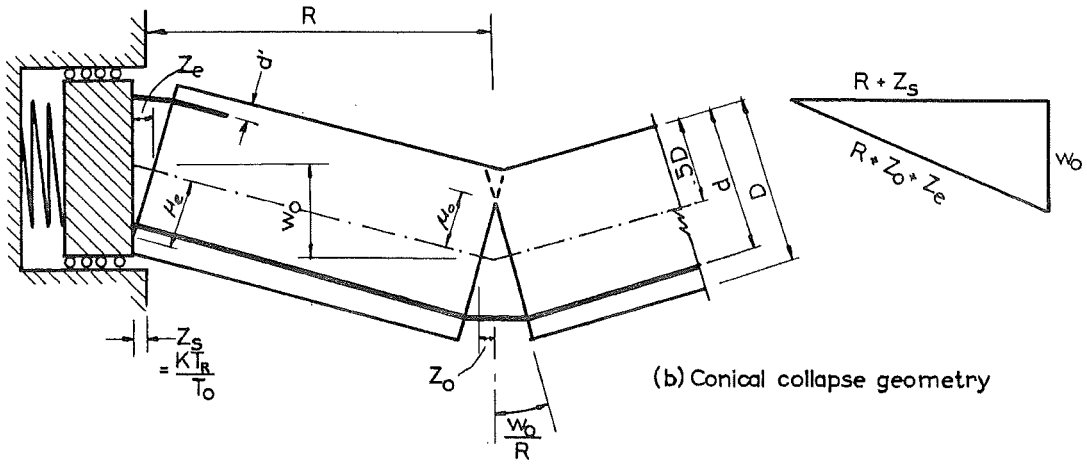
3.2.2 Analysis of a Uniformly Loaded Circular Slab With Finite Surround Stiffness

The slab of Figure 3.3 was analysed. Top and bottom steel is isotropic, the bottom steel covering the whole area while the top reinforcement extends only as far into the slab as is necessary. A conical collapse mode was assumed, the geometry of which is shown in Figure 3.3(b).

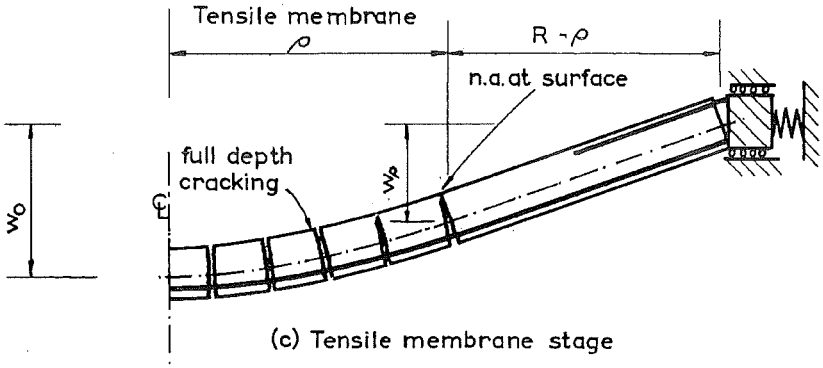
The support conditions allowed no deflection or



(a) Slab layout and element forces



(b) Conical collapse geometry



(c) Tensile membrane stage

FIGURE 3.3 CIRCULAR SLAB NOTATION

rotation but the edge of the slab could move outward against the springs of flexibility K per unit length of circumference.

By considering the strain rates of the conical collapse mechanism, it may be shown[7] that the distance, μ_θ, from the mid-depth to the neutral axis at a point along a sagging moment yield line at a distance, r, from the centre is given by

$$\mu_\theta = \mu_0 - .5w_o r/R \qquad \ldots.(3.9)$$

Forces on an element of the slab are shown in Figure 3.3(a) from which it may be seen that symmetry requires that no variation of forces with θ is possible.

Equilibrium of this element gives:

$$\frac{d}{dr}(rQ_r) + \frac{d}{dr}(rT_r\frac{dw}{dr}) = -qr \qquad \ldots.(3.10)$$

$$\frac{d}{dr}(rT_r) - T_\theta = 0 \qquad \ldots.(3.11)$$

$$\frac{d}{dr}(rM_r) - M_\theta - rQ_r = 0 \qquad \ldots.(3.12)$$

Equations 3.10 and 3.12 combine to give

$$\frac{d^2}{dr^2}(rM_r) - \frac{dM_\theta}{dr} + \frac{d}{dr}(rT_r\frac{dw}{dr}) = -qr \qquad \ldots.(3.13)$$

In all the above equations w = deflection at radius r and for this conical collapse is given by

$$w = w_o(1-r/R) \qquad \ldots.(3.14)$$

By considering the yield locus it is possible to relate μ_θ to the applied compression on the section.

The yield locus (Equation 3.3) is

$$(M/M_o) = 1+g(P/T_o)-h(P/T_o)^2 = f(M,P) \qquad ....(3.3)$$

and it may be shown by considering the strain components (curvature and extension) resulting from travel from one point to another on the yield locus, that

$$|\mu| = -\frac{\partial f}{\partial P}\Big/\frac{\partial f}{\partial M} \qquad ....(3.15)$$

From equation 3.3

$$|\mu| = gM_o/T_o-2hM_oP/T_o^2 \qquad ....(3.16)$$

Combination of Equations 3.9 and 3.16 for the radial yield lines gives:

$$\mu_\theta = \mu_o-.5w_or/R = gM_o/T_o-2hM_oP_\theta/T_o^2$$

from which

$$P_\theta/T_o = (g/2h-\mu_oT_o/(2hM_o))+w_oT_or/(4hM_oR) \qquad ....(3.17)$$

$$= A+Br \qquad ....(3.17a)$$

where A and B are constants for a given w_o.

Substitution for (P_θ/T_o) from Equation 3.17 in Equation 3.3 gives

$$M_\theta/M_o = (1+gA-hA^2) + (gB-2hAB)r-hB^2r^2 \qquad ....(3.18)$$

$$= A_1+B_1r+C_1r^2 \qquad \ldots.(3.18a)$$

Since $T_\theta = -P_\theta$, Equation 3.11 becomes

$$\frac{d}{dr}(rT_r) = -(A+Br)$$

from which $\frac{T_r}{T_o} = -(A+\frac{Br}{2})$ $\ldots.(3.19)$

Substitution for M_θ and T_r in Equation 3.13 gives:

$$\frac{M_r}{M_o} = \frac{r}{2}\left(B_1-\frac{w_oT_oA}{RM_o}\right)+\frac{r^2}{3}\left(C_1-\frac{w_oT_oB}{2RM_o}\right)+A_1-\frac{qr^2}{6M_o} \qquad \ldots.(3.20)$$

which is a condition imposed by equilibrium and strain rates due to conical collapse.

Now at the hogging moment yield line the reinforcement percentage will normally be different and the yield locus may be expressed as

$$M/M'_o = 1+g'(P/T'_o)-h'(P/T'_o)^2 \qquad \ldots.(3.3^*)$$

At the edge $M = M_R$, $T_R/T'_o = (T_R/T_o)(T_o/T'_o)$ and

$$M_R/M'_o = -(1-g'T_R/T'_o-h'(T_R/T'_o)^2) \qquad \ldots.(3.21)$$

The Johansen load of the slab may be shown to be

$$Q_J = \pi R^2 q_J = 6\pi\,(M_o+M'_o) \qquad \ldots.(3.22)$$

Equations 3.21 and 3.20 may be combined by equating values of M_R/M_o to give

$$\frac{qR^2}{6M_o} = A_1 + \frac{B_1 R}{2} + \frac{C_1 R^2}{3} - \frac{w_o T_o A}{2M_o} - \frac{w_o T_o BR}{6M_o} - \frac{M_R}{M_o} \quad \ldots.(3.23)$$

and the enhancement factor is

$$F = (qR^2/6M_o).(M_o/(M_o+M'_o)) = Q_M/Q_J$$

and in Equation 3.23:

$$A = \frac{g}{2h} - \frac{\mu_o T_o}{2hM_o} \ , \ B = \frac{w_o T_o}{4hM_o R} \quad \text{from Equation 3.17,}$$

$$A_1 = 1+gA-hA^2$$

$$B_1 = gB-2hAB$$

$$C_1 = -hB^2$$

$$\frac{M_R}{M_o} = \left(\frac{M_R}{M'_o}\right).\left(\frac{M'_o}{M_o}\right) = -\frac{M'_o}{M_o}\left(1-g'\left(\frac{T_R}{T'_o}\right)-h'\left(\frac{T_R}{T'_o}\right)^2\right)$$

Thus Equation 3.23 may be used to determine Q_M/Q_J for a given w_o provided μ_o can be expressed in terms of known quantities. This may be done by considering the geometry of the conical collapse (see Figure 3.3(b)). The outward movement of the edge is $Z_s = -KT_R/T_o$ and the slope length along the slab mid-depth is $R+Z_o+Z_e$. At collapse

$$(R+Z_s)^2+w_o^2 = (R+Z_o+Z_e)^2 \quad \ldots.(3.24)$$

But $Z_e = \frac{\mu_e w_o}{R}$, $Z_o = \frac{\mu_o w_o}{R}$ for small $\frac{w_o}{R}$ so that Equation 3.24 becomes

$$\left(\frac{w_o}{R}\right)^2(\mu_o+\mu_e)^2 + 2w_o(\mu_o+\mu_e) - w_o^2 + 2RK\left(\frac{T_R}{T_o}\right) - \left(K\frac{T_R}{T_o}\right)^2 = 0 \quad \ldots.(3.25)$$

and from Equation 3.16:

$$|\mu_e| = (M'_o/T'_o)(g' + 2h'(T_R/T_o)(T_o/T'_o)) \quad \ldots.(3.26)$$

T_R/T_o may be found from Equation 3.19 and substituted in 3.26 to give

$$\left(\frac{\mu_e}{D}\right) = \frac{(1-d')}{d}\left(\frac{\mu_o}{D}\right) + \frac{g'}{k} - \frac{g(1-t)}{k(1-t')} - \frac{1}{4}\frac{(1-d')}{d}\left(\frac{w_o}{D}\right) \quad \ldots.(3.27)$$

$$= C_o\left(\frac{\mu_o}{D}\right) + C_2$$

In which

$$k = \frac{(D/d)}{(1-t)} \quad , \quad k' = \frac{D/(1-d')}{(1-t')} \quad , \quad t = pf_y/(1.7f'_c)$$

Now from 3.19:

$$(K/D)(T_R/T_o) = (K/D)(k/2h)(\mu_o/D) - (K/D)(g/2h) -$$

$$(K/D)(w_o/D)/8h = C_3(\mu_o/D) + C_4 \quad \ldots.(3.28)$$

Substitution of Equations 3.27 and 3.28 in Equation 3.25 yields a quadratic equation in (μ_o/D), relating it to known quantities to a given deflection, w_o; viz.

$$\left(\frac{\mu_o}{D}\right)^2\left[\left(\frac{w_o}{R}\right)^2(1+C_o)^2 - C_3^2\right] + 2\left(\frac{\mu_o}{D}\right)\left[\frac{C_2}{D}(1+C_o)\left(\frac{w_o}{R}\right)^2 + \left(\frac{w_o}{D}\right)(1+C_o) + \frac{RC_3}{D} - \frac{C_3C_4}{D}\right]$$

$$+\left(\frac{C_2}{D}\right)^2\left(\frac{w_o}{R}\right)^2 + 2\left(\frac{w_o}{D}\right)\left(\frac{C_2}{D}\right) - \left(\frac{w_o}{D}\right)^2 + \frac{2C_4R}{D^2} - \left(\frac{C_4}{D}\right)^2 \quad \ldots.(3.29)$$

Equations 3.29 and 3.23 may thus be used in turn to find Q_M/Q_J for a given (w_o/D) ratio in a slab of known

properties, and load-deflection curves may be obtained for varying lateral restraint conditions for which (w_o/D) does not exceed .5 at the centre.

After (w_o/D) exceeds .5 at the centre, a tensile membrane forms from the centre and although the equilibrium equations still apply to the remaining conical portion, the relationship between the radius of the tensile membrane region and (T_R/T_o) is not explicit. A load-deflection relation for this region was obtained by assuming a relation between the two.

CONDITIONS AFTER PLASTIC MEMBRANE COMMENCES AT THE CENTRE

When w_o/D exceeds .5 the foregoing analysis is invalidated, and conditions become more complex since the geometry may no longer be used to ascertain T_R/T_o explicitly. However, in order to obtain a continuous curve, an approximate analysis was made. Wood's analysis of a simply supported slab[7] may be followed but without the condition that the radial tension, T_R, is equal to zero at the edge.

Wood shows that:

$P_\theta/T_o = A+Br$ for the conical portion

in which $B = (T_o/4hM_o)(w_\rho/(R-\rho))$ ....(3.30)

for a tensile membrane extending to a radius ρ from the

centre and a slab deflection, w_ρ, at the junction between tensile membrane and the outer cone (Figure 3.3(c)).

Since $P_\theta/T_o = -1$ at $r = \rho$, $A = -1-B\rho$.

From Equation 3.11

$$T_r/T_o = -A-Br/2+C/r$$

and the condition that $T_r/T_o = 1$ at $r = \rho$ gives $C = \frac{-B\rho^2}{2}$.

The condition at the edge of the slab is then

$$T_R/T_o = 1-B(R-\rho)^2/2R \qquad ....(3.31)$$

Equating values of B from Equations 3.30 and 3.31 relates w_ρ and ρ:

$$w_\rho = (8hM_o/T_o)(1-T_R/T_o)/(1-\rho/R) \qquad ....(3.32)$$

Integration of Equation 3.10 gives

$$rQ_r+rT_r\frac{dw}{dr} = \frac{-qr^2}{2} + C_o$$

but $Q_r = 0$ at $r = \rho$, $T_r = T_o$ at $r = \rho$ and $\frac{dw}{dr} = w_\rho/(R-\rho)$

so that C_o may be found, and

$$Q_r = \frac{-qr}{2} + \frac{T_r w_o}{(R-\rho)} + \frac{q\rho^2}{2r} - \frac{\rho\, w_o T_o}{r(R-\rho)} \qquad ....(3.33)$$

Equilibrium of radial moments for the cone gives

$$\frac{d}{dr}(rM_r)-M_\theta-rQr = 0 \qquad ....(3.12)$$

and since $P_\theta/T_o = A+Br$ where A and B are constants for a

given value of p, M_θ may be expressed using the yield locus: $M_\theta/M_o = A_1+B_1r+C_1r^2$ where A_1, B_1 and C_1 are directly related to B.

Integration of 3.12 with the condition that M_r/M_o = 1-g-h at $r = \rho$ finally results in:

$$\frac{qR^2}{6M_o}\left(1-3\left(\frac{\rho}{R}\right)^2+2\left(\frac{\rho}{R}\right)^3\right) = \left(A_1+\frac{B_1R}{2}+\frac{C_1R^2}{3}\right)+\left(\frac{\rho}{R}\right)\left(A_1+\frac{B_1\rho}{2}+\frac{C_1\rho^3}{3}\right)$$

$$+\frac{\rho}{R}\left(1-g-h\right)+\frac{w_\rho T_o}{2M_o}\left(1-\frac{\rho}{R}\right)-\frac{BR}{6}\frac{w_\rho T_o}{M_o}\left(1-\frac{\rho}{R}\right)^2-\frac{M_R}{M_o} \quad \ldots.(3.34)$$

Equation 3.34 expresses q in terms of known quantities and the unknown T_R/T_o.

At the start of the tensile membrane, ρ/R = 0 and since A = -1 at this stage Equations 3.23 and 3.34 are identical.

After the central tensile net has formed, the outward movement of the edges of the slab becomes indeterminate.

Equation 3.32 shows that for a chosen value of ρ/R, w_ρ may be calculated if T_R/T_o is known. The relationship between T_R/T_o and ρ/R assumed was

$$\left(\frac{T_R}{T_o}\right)_{\rho/R} = \left(\frac{T_R}{T_o}\right)_{\rho/R=0}\left(1-\frac{\rho}{R}\right) \quad \ldots.(3.35)$$

This gave satisfactory results but is not the only possible solution. Three other possible variations were investigated, viz:

$$\left(\frac{T_R}{T_o}\right)_{\rho/R} = \left(\frac{T_R}{T_o}\right)_{\rho/R=0}\left(1-\frac{\rho}{R}\right) + \frac{\rho}{R} \qquad \ldots.(3.36)$$

$$\left(\frac{T_R}{T_o}\right)_{\rho/R} = \left(\frac{T_R}{T_o}\right)_{\rho/R=0} \qquad \ldots.(3.37)$$

$$\left(\frac{T_R}{T_o}\right)_{\rho/R} = \left(\frac{T_R}{T_o}\right)_{\rho/R=0}\left(1-\left(\frac{\rho}{R}\right)^3\right) + \left(\frac{\rho}{R}\right)^3 \qquad \ldots.(3.38)$$

The difference between these assumptions is shown in Figure 3.4 from which it may be seen that the difference is least for low surround stiffness but Equations 3.35 and 3.36 give similar results for the whole range of K/D values. Equations 3.37 and 3.38 imply a low rate of fall-off in T_R/T_o with increase in ρ/R and do not give consistent results throughout the range of surround stiffness.

However, when the tensile region forms, the assumption of rigid-plasticity of the concrete does not apply accurately and Equation 3.35 is sufficient to describe behaviour of the slab after the tensile membrane starts.

3.2.3 EFFECT OF VARIATION OF SLAB PARAMETERS ON THE BEHAVIOUR OF THE SLAB

The above analyses enable the determination of the load-deflection relationship of a circular slab under uniform load. Simple computer programmes were written to obtain this relationship for slabs of varying properties.

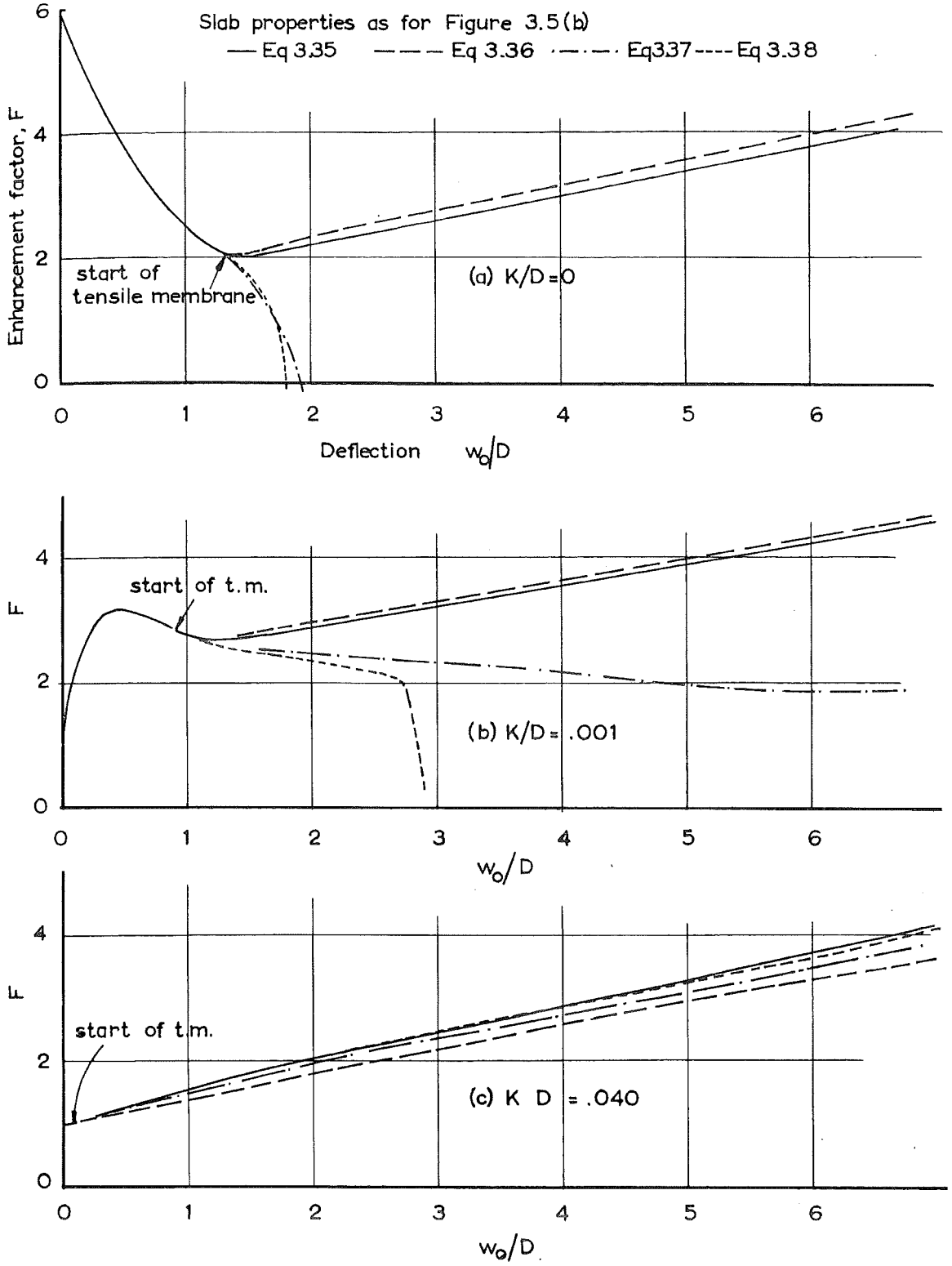


FIGURE 3.4 COMPARISON OF TENSILE MEMBRANE EQUATIONS

The variables investigated were:

R/D = ratio of radius to depth of slab

K = measure of surround flexibility

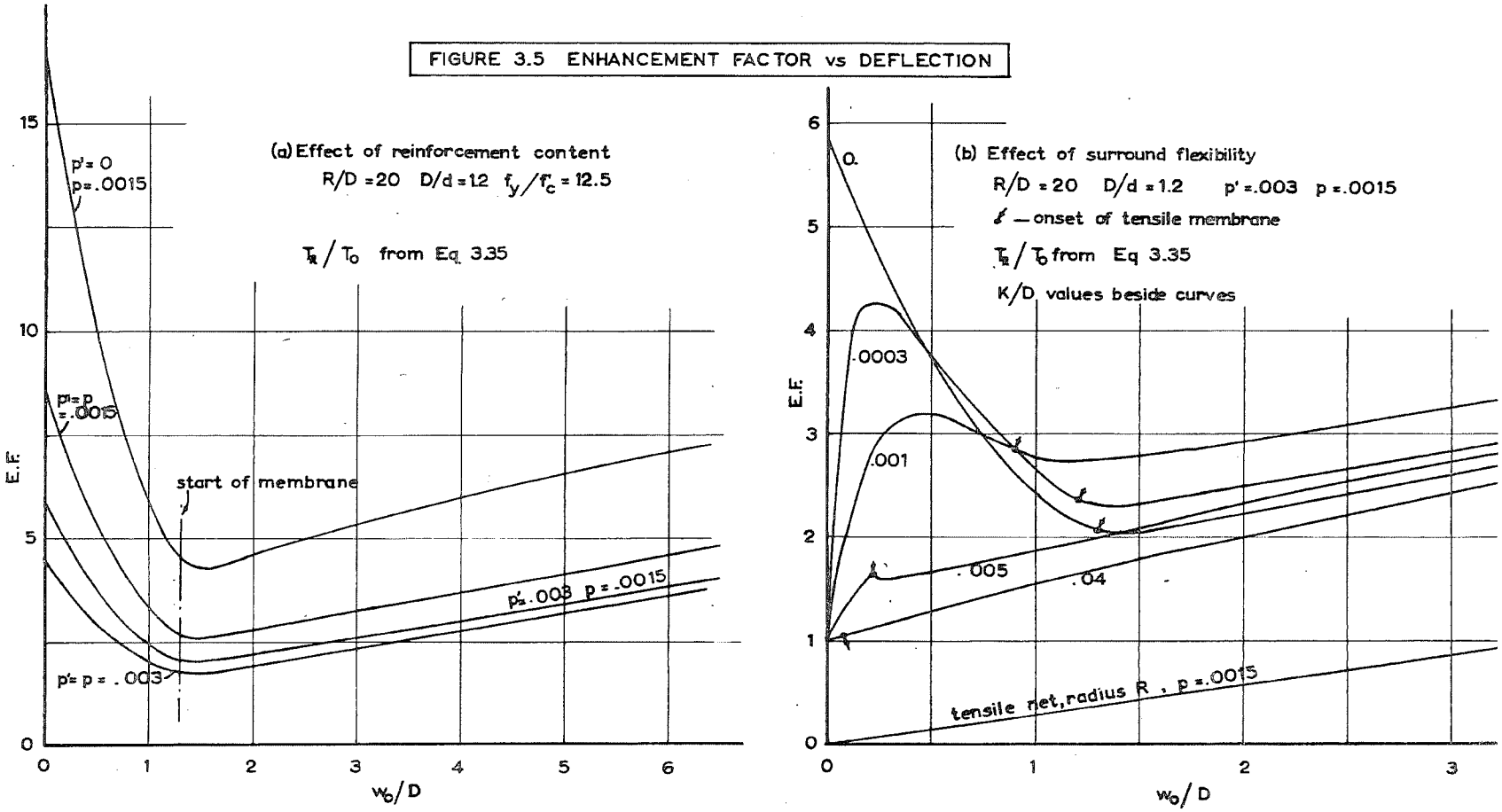
p',p = reinforcement ratios in the top and bottom of the slab.

Figure 3.5(a) shows the load-deflection relationships obtained for varying steel percentages,top and bottom. All the curves in this figure show a maximum enhancement at zero deflection.

In Figure 3.5(b), the effect of surround flexibility is illustrated both in its effect on the maximum enhancement and on the deflection at which this occurs. The values of surround flexibility shown are for K/D where K is the inward movement of the surround due to a radially inward force p.d per unit length of circumference.

The initial slope of these curves is smaller for increasing K/D and the deflection at which zero slope occurs increases with K/D. However, as the flexibility of the surround is increased, a stage is reached beyond which the tensile membrane starts at the centre ($\mu_o/D \geq .5$) before zero slope is attained. Note that the case for which K/D = .04 is tending to the solution for no lateral restraint.

FIGURE 3.5 ENHANCEMENT FACTOR vs DEFLECTION



3.2.4 Comparison With Some Experimental Results

3.2.4.1 Summary and Introduction

Equation 3.23 was used to compare the load-deflection relationships of two sets of experimental results obtained from tests on square slabs restrained at the edges. These were two slabs tested by Wood[7] with all edges restrained by a monolithically cast edge beam and two slabs tested at M.I.T. by Brotchie, Jacobson and Okubo[15] in which the separately cast specimens were placed within a rigid surrounding frame. Because the collapse mechanism and the collapse loads of square and circular slabs are nearly identical, Equation 3.23 could be expected to give good results in comparison with these experimental results. Only a simple and approximate assessment of surround flexibility could be made in each case.

Agreement between the calculated and required surround flexibilities was good for the lightly reinforced, slender slabs tested by Wood. In the more heavily reinforced, thicker slabs tested at M.I.T. sensitivity to change in surround flexibility was not as great and, in general, the flexibility required to reproduce the experimentally determined enhancement was greater than that given by the approximate analysis.

3.2.4.2 Properties of the Slabs Used in Comparison

The properties of the slabs are summarised in Table 3.1.

Table 3.1. Slab properties.

Authority	Mark	Dimensions (Inches)	R/D	p' %	p %	D/d	f_y/f'_c*
Wood	FS12	68 x 68 x 2.25	15.1	0	.25	1.24	7.17
Wood	FS13	68 x 68 x 2.25	10.0	.25	.25	1.24	8.80
M.I.T.	46	15 x 15 x .75	10.0	0	1.0	1.34	10.95
M.I.T.	48	15 x 15 x .75	10.0	0	2.0	1.34	12.31

* On the assumption that $f'_c = .8u$

3.2.4.3 Assessment of Surround Flexibility

Surround flexibility was defined as the outward movement of the surround under a force of pdf_y ($=T_o$). For circular slabs this is uniform around the circumference but for square slabs this is not so. To assess the surround flexibility of the square slabs of Table 3.1, the maximum deflection of a side of the surround was computed using Equations 5.3, 5.4, 5.8 and 5.6. These gave the outward movement of the surround due to bending, shear and axial deformation of the surround. The effective surround stiffness will be further reduced by shortening of the loaded slab under compressive membrane forces. Thus, the total surround stiffness was assessed by summing the outward movement of the surround under T_o and the shortening of a strip of slab of unit width under a force T_o. The slab strip shortening was calculated on the basis of an uncracked concrete section. Thus in this comparison the

value of K/D for a circular slab was assumed to be represented by the maximum effect occurring in the case of a square slab. Summaries of the assessment of surround stiffness are given below.

(i) Wood's Slabs[7]

The section of the surrounding beams used for these tests is shown in Figure 3.5. The yield stress of the reinforcement was 33,800 psi and the modulus of elasticity of the concrete was assumed to be 3.5×10^6 psi.

$$\therefore \quad T_o = pdf_y = 153 \text{ lb/in}$$

The force, W, on half the surround span was therefore 5200 lb.

Assuming a modular ratio of 10.0, the equivalent area of concrete in the surround section was 270 in^2 and the moment of inertia = 6140 in^4. The equivalent plain concrete surround was taken as t x b such that $t.b = 270$ in^2; $tb^3/12 = 6140$ in^4. Whence t = 16.4 in, b = 16.5 in. Therefore in Equations 5.3, 5.4, 5.8, 5.6;

$$\frac{a_x}{b_x} = 2.07, \quad k = .183$$

Thus:

$$\Delta_e.\frac{tE}{W} = 2.07, \quad \Delta_s \frac{tE}{W} = 3.56, \quad \Delta_B.\frac{tE}{W} = 6.28$$

The slab strip shortening over half the span is $\frac{PL}{EA} = \Delta_{ss}$

$= 6.61 \times 10^{-4}$.

Now, $K/D = (\Delta_e + \Delta_s + \Delta_B + \Delta_{ss})/D = 7.69 \times 10^{-4}$

for $W = 5200$, $t = 16.4$, $E = 3.5 \times 10^6$ psi.

(ii) M.I.T. Slabs[15]

For these slabs, the steel surrounding frame was as shown in Figure 3.6 and in addition the continuous slabs were 29" x 29" overall, giving a 7" concrete surround. Only a very approximate assessment of surround movement was made since slab strip shortening formed the bulk of the total surround flexibility. The steel yield stress was 60,000 psi, and for two per cent of steel:

$$T_o = pdf_y = 673 \text{ lb/in.}$$

Under this force the outward movement of the steel portion only of the surround was computed. The slab strip shortening, Δ_{ss}, was 19.3×10^{-4} in, $\Delta_{ss}/D = 25.6 \times 10^{-4}$. The final values of K/D for the one per cent and two per cent reinforcements were made up as follows:

	p = 1%	p = 2%
K/D due to surround deformation)	1.0×10^{-4}	2.0×10^{-4}
K/D due to slab strip shortening	12.8×10^{-4}	25.6×10^{-4}
Total K/D	13.8×10^{-4}	27.6×10^{-4}

3.2.4.4 Comparison of Load-Deflection Curves

For Wood's Slab FS12[7] a value of K/D of .0007 gave a maximum load slightly in excess of the experimentally determined load (see Figure 3.6(a)). The value of .001 for K/D underestimated the maximum load but follows the experimental curve very closely up to an enhancement factor of 10. These values of K/D which give good agreement with the experiment compare well with the value of .000769 arrived at by approximate analysis.

Slab FS13 failed when the ratio of deflection to depth was 0.5 and the load 4.38 times the Johansen load. The value of K/D = .000769 overestimated the load considerably and even the value .001 which gave good agreement in FS12 was an overestimate for FS13 (see Figure 3.6(b)). A value of .0013 gave closest agreement.

Figure 3.7(a) shows the two experimentally determined curves for the $\frac{3}{4}$" thick M.I.T. slabs. For one per cent reinforcement a value of K/D = .0026 gave the correct maximum load while K/D = .00138, computed from slab strip shortening, overestimated the maximum load by approximately 10 per cent. For two per cent reinforcement a value of .012 was required as against .00276 calculated which had overestimated the collapse load by 18 per cent. The falling branches of both sets of theoretical curves agree well with those determined experimentally and overall similarity of shape is good.

FIGURE 3.6 COMPARISON WITH WOOD'S SLABS

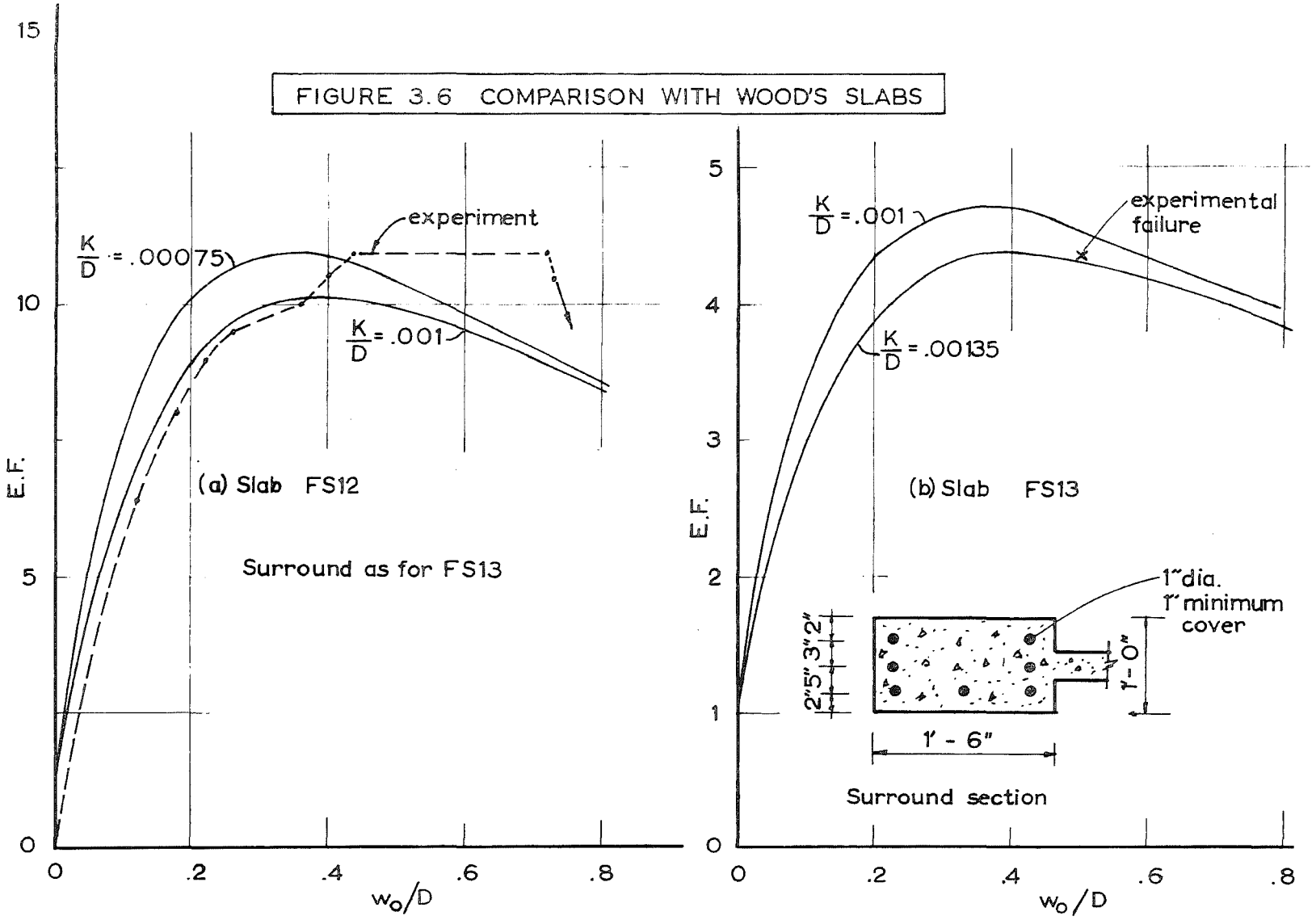
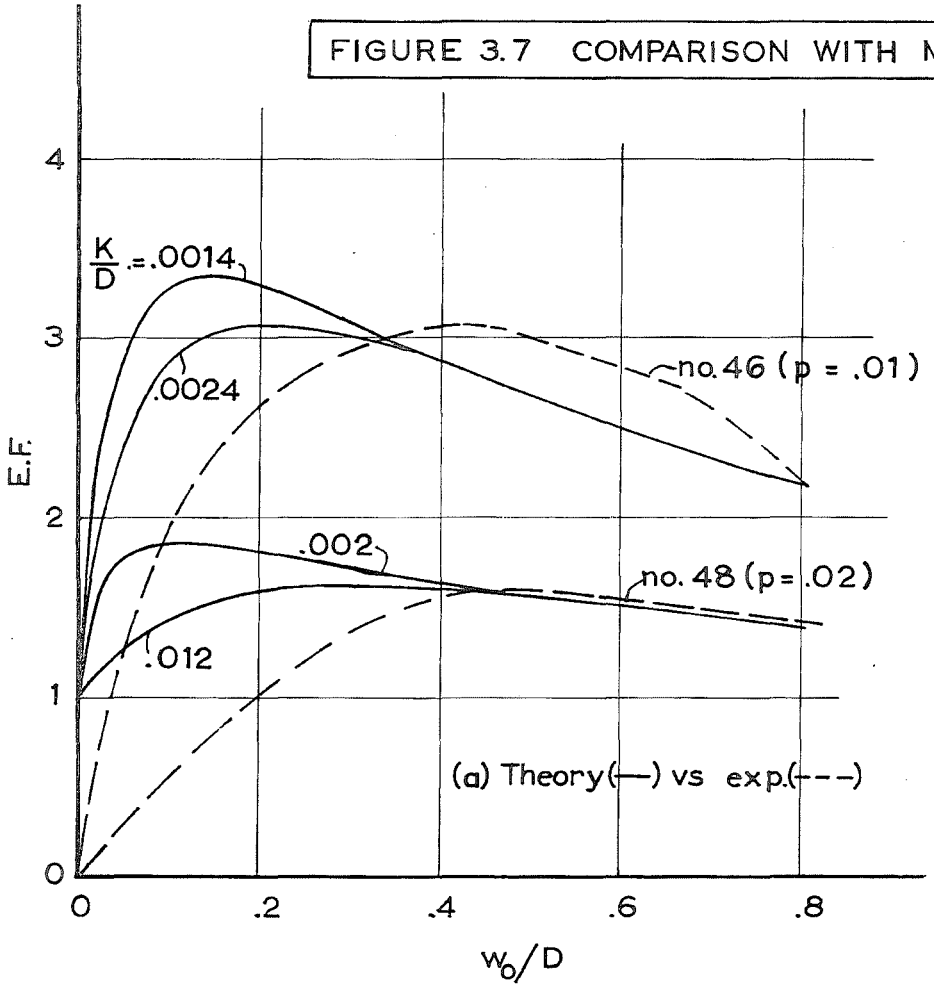
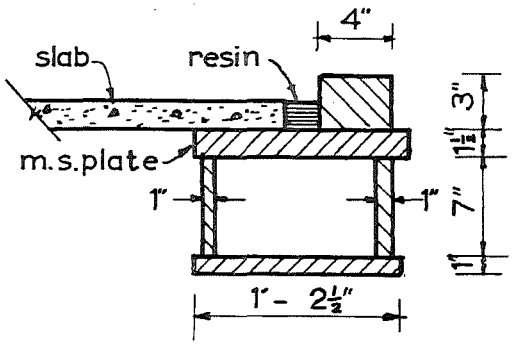


FIGURE 3.7 COMPARISON WITH M.I.T. SLABS





(b)Support condition and surround section
(approx. dimensions only)

3.2.5 Discussion and Conclusion

In the analytical approach presented, the effect of finite lateral stiffness of the slab surround was successfully taken into account. The load-deflection curves were similar to those obtained experimentally, expecially where enhancement factors were large. Crushing of the concrete caused a divergence of the theoretical and experimental curves after a maximum had been reached.

This greater similarity at large enhancement factors is attributable, in part, to the effect of the assumption that the materials were rigid-plastic. The deflection at an enhancement factor of 1.0 was always zero and in cases of low enhancement, this departure from actual behaviour was relatively large.

Although the analysis does not strictly hold for the situation, it is interesting to note that better agreement is obtained when the theoretical curve is shifted bodily so that the experimental and theoretical deflections are equal at an enhancement factor of 1.0.

For an immovable surround, the enhancement factor was a maximum at zero deflection, the maximum value varying only with the section properties in accordance with the findings of Section 3.1.2. When the surround stiffness was finite, the maximum enhancement factor attained was governed, not only by the section properties, but by the ratio of span to depth of the slab and the stiffness of

the surround.

The reduction in the maximum load with increase in surround flexibility was to be expected but the equations derived provide a means of assessing the maximum enhancement.

The early onset of the tensile membrane at the centre could not be expected in practice: the assumption that the materials are rigid-plastic caused an underestimate of this deflection in the same way as it caused the underestimate of the deflection at which the enhancement factor was 1.0. However, the slopes of the load-deflection curves indicate the degree of enhancement which would be available.

For reinforcement ratios greater than .01 the relative effect of membrane action was small. Although such slabs are less sensitive to increase in surround flexibility than more lightly reinforced slabs, lateral restraint brings only small rewards.

The assessment of the equivalent surround flexibility, K/D, requires careful study. In addition to the effects considered, the following are of importance:

(a) Shrinkage of the slab away from the surround

(b) Creep deformation of surround and slab

(c) Cracking of the elements comprising the surround

(d) Deflection just prior to the onset of compressive membrane action.

The effect of these factors could well account for the discrepancies evident in the comparison with tests.

Clearly, in the design of a slab with allowance for membrane action enhancement, the surround flexibility should be overestimated by an amount dependent upon the sensitivity of the slab in question to the change in surround flexibility.

CHAPTER 4

THE EFFECT OF PANEL MEMBRANE ACTION OF THE DESIGN OF SUPPORTING BEAMS

4.1 SUMMARY

The presence of compressive membrane forces in the panels of a slab and beam floor affects the flexural and torsional capacity of the supporting beams due to the axial tension and lateral loads applied to them. For this situation, a method of determining the beam moments is developed which is similar to methods used when membrane action is not considered. A method of allocating flexural steel to the critical sections of a T-beam subject to axial load and moment is then developed on the basis of ultimate strength theory.

Finally, the effects of panel membrane action on the torsion induced in the spans of supporting beams are examined.

4.2 DETERMINATION OF BEAM MOMENTS

Consider a typical interior panel of a slab and beam floor (Figure 4.1(a)). Let this panel be orthotropically reinforced with equal intensities of hogging moments along

opposite edges (Figure 4.1(b)). The quantities m_x, m_y, m'_x, m'_y represent the average moments per unit width, acting about the mid-depth of the slab section.

The yield line pattern shown in Figure 4.1(b) applies to the case when no membrane forces are present. Compressive membrane forces will enhance the load carrying capacity of the panel. If it is assumed that the presence of membrane forces does not alter the plan geometry of the collapse mechanism or introduce nodal forces at I or J then the collapse mechanism of Figure 4.1(b) may be used to determine the collapse load of the panels when membrane action is considered.

Consider the design of a floor including the effect of membrane action. From the design of the panel (e.g. by the theory due to Park[11] the distribution and magnitude of the membrane forces along a yield line would be known and hence the values of m'_x, m'_y, m_x, m_y could be calculated. The magnitude and line of action of the resultant of the membrane forces acting on a yield line may be determined. The resultant forces are shown in Figures 4.1(f), (g), (h), (i) and (j). In Figures (f) and (g) it has been assumed that the distribution of c_x along KF is the same as that along IA. That these two resultants have the same line of action in the vertical direction results from the assumption that the slab elements are planar between yield lines.

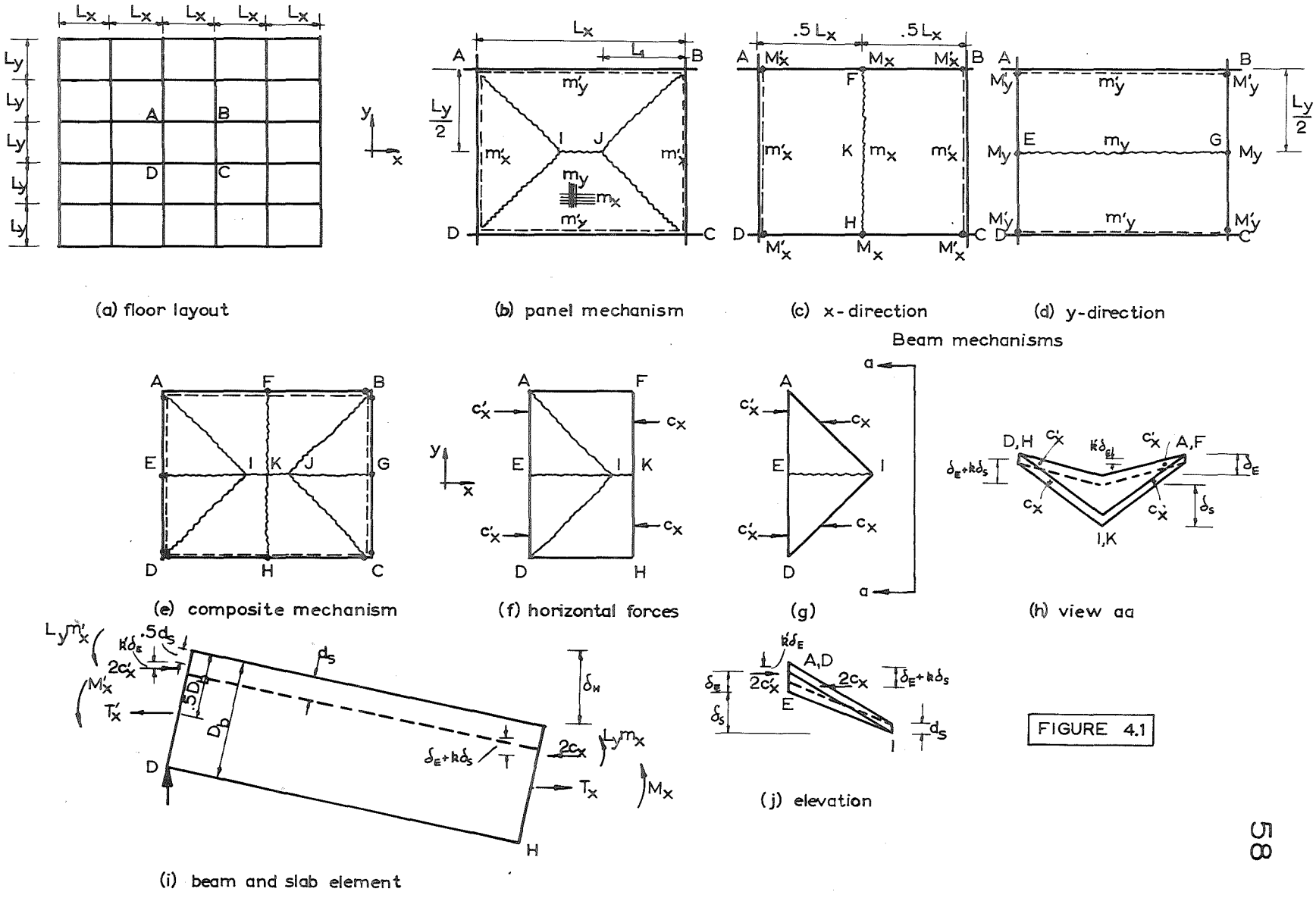

(a) floor layout
(b) panel mechanism
(c) x-direction
(d) y-direction
Beam mechanisms
(e) composite mechanism
(f) horizontal forces
(g)
(h) view aa
(i) beam and slab element
(j) elevation

FIGURE 4.1

The possible beam collapse mechanisms (Figure 4.1 (c), (d)) must be guarded against by the provision of suitably strong beams. If the panels are designed allowing for membrane action enhancement, the beams must be designed to carry moments induced by the enhanced load together with the tensions induced in them by the compressive membrane forces in the panels on either side.

If the beams are not designed for both these effects, the beam collapse mechanisms will form first. At least, then, the beams must be so designed that both panel and beam mechanisms form simultaneously, as in Figure 4.1(e). This composite mechanism will form when the panel and beam mechanisms each have the same ultimate load. It is important to note that, when membrane action is considered, compression will be present along the slab yield lines HF and EG of Figure 4.1(c) and (d). Analysis of the composite mechanism with membrane action may follow closely that applicable to this case when membrane action is not considered. This similarity is best seen when both analyses are performed together, as below. Let the Johansen load be w_J and the enhanced load $F.w_J$. For the panel mechanism, moment equilibrium about AD for portion AID gives, at Johansen load,

$$\frac{w_J L_y . L_1^2}{6} = L_y(m_{xJ} + m'_{xJ}) \qquad \ldots.(4.1)$$

and for AIJB, moment equilibrium about AB gives

$$w_J L_y^2 \left(\frac{L_x}{8} - \frac{L_1}{6}\right) = L_x(m_{yJ} + m'_{yJ}) \qquad \ldots.(4.2)$$

From which w_J and L_1 may be determined for known m'_{xJ}, m'_{yJ}, m_{xJ}, m_{yJ}.

For the beam mechanism in Figure 4.1(c), there is no shear along FH and moments about AD for AFHD gives

$$M'_{xJ} + M_{xJ} = \frac{w_J L_x^2 L_y}{8} - L_y(m'_{xJ} + m_{xJ}) \qquad \ldots.(4.3)$$

and similarly for the mechanism of Figure 4.1(d)

$$M'_{yJ} + M_{yJ} = \frac{w_J L_y^2 L_x}{8} - L_x(m'_{yJ} + m_{yJ}) \qquad \ldots.(4.4)$$

When membrane action is considered in design, the forces c'_x and c_x are not zero and their effect is to enhance the yield moments. The secondary effect of the variation of the level of the lines of action of these forces must be considered. At a load of Fw_J we get:

$$\frac{Fw_J L_y L_1^2}{6} = L_y(m_x + m'_x) - 2c_x(\delta_E + k\,\delta_S - k'\,\delta_E) \qquad \ldots.(4.5)$$

since $c'_x = c_x$, and for AIJB:

$$Fw_J L_y^2 \left(\frac{L_x}{8} - \frac{L_1}{6}\right) = L_x(m_y + m'_y) - 2c_y(\delta_F + k\,\delta_S - k''\,\delta_F) \qquad \ldots.(4.6)$$

and for the beam mechanism in Figure 4.1(c) referring to Figure 4.1(i) and taking $T_x = T'_x$ we have from moments about D:

$$M'_x + M_x = \frac{Fw_J L_x^2 L_y}{8} - L_y(m'_x + m_x) - T_x(\delta_H) + 2c_x(\delta_H + \delta_E + k\delta_S - k'\delta_E) \quad \ldots.(4.7)$$

Combination of Equations 4.1 and 4.5 gives

$$L_y(m'_x + m_x) = FL_y(m'_{xJ} + m_{xJ}) + 2c_x(\delta_H + \delta_E + k\delta_S - k'\delta_E) \quad \ldots.(4.8)$$

Substituting 4.8 into 4.7:

$$M'_x + M_x = \frac{Fw_J L_x^2 L_y}{8} - FL_y(m'_{xJ} + m_{xJ}) - 2c_x(\delta_H + \delta_E + k\delta_S - k'\delta_E) - T_x\delta_H + 2c_x(\delta_H + \delta_E + k\delta_S - k'\delta_E)$$

$$\therefore \quad M'_x + M_x = F\left[\frac{w_J L_x^2 L_y}{8} - L_y(m'_{xJ} + m_{xJ})\right] - T_x\delta_H$$

and using Equation 4.3 we get the relation

$$M'_x + M_x = F(M'_{xJ} + M_{xJ}) - T_x\delta_H \quad \ldots.(4.9)$$

Although the term, $T_x\delta_H$, does help in reducing the total free moment from the directly factored Johansen load sum, it is reasonable and conservative to neglect its contribution in this case.

Thus when membrane action in the panels is taken into account the sum of the beam moments may be obtained by using the normal methods employed when membrane action is not present, provided the load used is the enhanced panel load.

For continuous slab and beam floor systems, Park[22] has shown that, except for panels with unsupported exterior edges, the sum of the beam moments, $M'_x + M_x$, is the same whether calculated by analysis of the beam collapse mechanisms or by application of a load distribution to the beam equivalent to the adjacent trapezoidal segments of the slab. If the term, $T_x . \delta_H$, of Equation 4.9 is ignored, then it follows that this interrelation will also apply for cases with membrane action.

The beams must also be designed to accommodate the tensions induced. At a support section the forces in concrete and steel must sum to

$M'_x + T'_x$ and at mid-span to $M_x + T_x$.

The value of $T'_x = T_x = 2c_x = 2c'_x$ will be known from panel design but, so far, only the sum of $M'_x + M_x$ has been found and the ratio of M'_x to M_x needs to be determined.

In cases without membrane action the ratio of M'_{xJ} to M_{xJ} may be found by consideration of the flexural stiffness of the beams with due allowance being made for moment redistribution within acceptable limits.

When membrane action is allowed for, two further aspects must be considered before the ratio of support to mid-span moment is found:

(i) Dependence upon moment redistribution would lead to large deflections in the beams at ultimate load which could adversely affect the development of

membrane action in the panels of the floor. It is therefore recommended that special care should be taken to minimise moment redistribution.

(ii) The effect of tension on the beam moments is important. The beam moments have been defined as acting about the mid-depth where the net tension is taken to act. But the tension in the beams is due to slab compression acting near the level of the mid-depth of the slab which will normally be above the mid-depth of the beam.

This is equivalent to the application of a tension at the mid-depth of the beam plus a hogging moment (see Figure 4.2(a) and (b)).

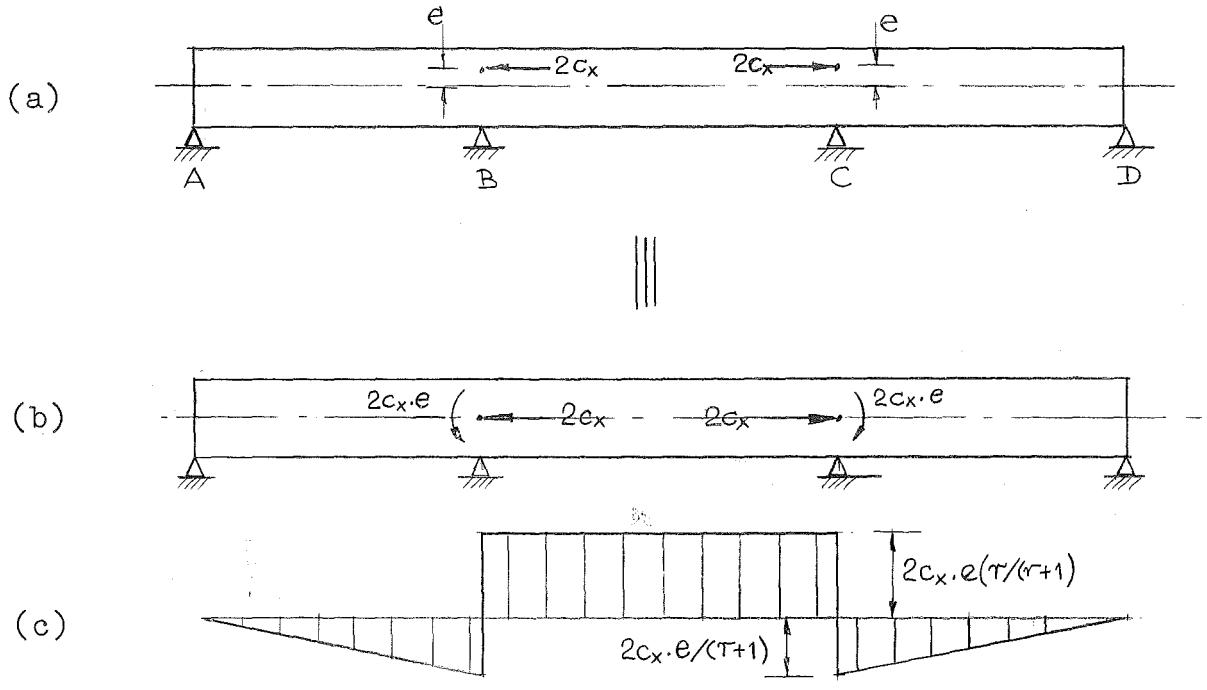


FIGURE 4.2. EFFECT OF COMPRESSIVE FORCES ON BEAM MOMENTS.

In Figure 4.2(a) the sum of the compressive forces, $2c_x$, in the panels on either side of the beam span, BC, have been shown applied at a distance, e, above the mid-depth of the beam. This is the manner in which the beam tension is applied in a slab and beam floor and Figure 4.2(b) shows the equivalent actions at the mid-depth of the beam. The tension is now applied at the mid-depth and in no way affects the moments about the mid-depth of the beam. The couples $2c_x.e$ do affect these moments, in fact producing a bending moment diagram of the shape shown in Figure 4.2 (c) in which r is the ratio of the flexural stiffness of the spans ($K_{CB}:K_{CD}$). Thus, if the amount of moment re-distribution is to be kept to a minimum, when membrane action is considered, account should be taken of this effect.

The moments at the supports and at mid-span due to vertical loads only will be in the same ratio for any load. More particularly, the moments due to the Johansen load (M'_{xJ} and M_{xJ}) will be in the same ratio as those due to the enhanced load (denoted M'_{xV} and M_{xV}). Thus for an enhancement of load equal to F,

$$M'_{xV} = F\ M'_{xJ},\quad M_{xV} = F\ M_{xJ}$$

When the effect of tension is added then

$$M'_x = F\ M'_{xJ} + 2c_x.e\frac{r}{(r+1)} \qquad \ldots\ldots(4.10)$$

$$M_x = F\,M_{xJ} - \frac{2c_x.e.r}{(r+1)} \qquad \ldots.(4.11)$$

Since the values of e, r, c_x, F, M'_{xJ}, M_{xJ} will be known, M'_x and M_x may be found. The effect of membrane action on the relative proportions may be calculated, being dependent upon the values of c_x, e and r.

Flexural steel may be allocated to the sections according to the ultimate strength method. Since the neutral axis will be near the compression face the sections can be designed on the assumption that the neutral axis is in the flanges and the effect of "compression" steel is negligible.

For the support section A of Figure 4.3(a), consideration of moment and force equilibrium gives:

$$T'_x = A'_s f_y - .85 f'_c a' b \qquad \ldots.(4.12)$$

$$M'_x = A'_s f_y\left(\frac{D}{2} - d'\right) + .85 f'_c a' b\left(\frac{D}{2} - \frac{a'}{2}\right) \qquad \ldots.(4.13)$$

Eliminating a' from these equations and making the resulting equation non-dimensional yields

$$\frac{1}{1.7}\left(\frac{p' f_y}{f'_c}\right)^2 - \left[\frac{D}{d} - \frac{d'}{d} + \frac{2T'_x}{1.7 f'_c bd}\right]\left(\frac{p' f_y}{f'_c}\right)$$

$$+ \frac{T'_x}{f'_c bd}\left(\frac{D}{2d}\right) + \frac{T'_x}{1.7 f'_c bd}\Bigg) + \frac{M'_x}{f'_c bd^2} = 0 \qquad \ldots.(4.14)$$

and similarly at mid-span, C,

$$\frac{1}{1.7}\left(\frac{b}{b_f}\right)\left(\frac{p f_y}{f'_c}\right)^2 - \left[1.0 + \frac{2T'_x}{1.7 f'_c bd}\left(\frac{b}{b_f}\right)\right]\left(\frac{p f_y}{f'_c}\right) + \frac{T'_x}{f'_c bd}\left(\frac{D}{2d} + \frac{T'_x}{1.7 f'_c bd}\left(\frac{b}{b_f}\right)\right) + \frac{M}{f'_c bd^2} = 0 \qquad \ldots.(4.15)$$

Equations 4.14 and 4.15 are readily solved and show the effect of tension on the longitudinal steel requirements.

Influence of "Compression" Steel

The presence of steel near the compression face of the concrete has only a secondary effect on the capacity of the section. That this is so may be illustrated by considering the effect of its placement, after the section has been designed to include tension steel only. Compression steel may be above, below or at the depth of the neutral axis as given by tension steel design.

When placed at the neutral axis depth it has no effect. When placed in the compressive strain zone, this steel is in compression and the force introduced increases the moment about the mid-depth, but decreases the tension. When it is placed in the tensile strain region the moment reduces but the tension increases.

The conclusion that the compression steel has little effect on the capacities of the critical sections at ultimate load does not imply that its placement in the beam is of little value. Apart from serving to increase the ductility of high moment sections, its presence will substantially improve the tension carrying capacity of sections subject to low moment. In cases where the moment about the mid-depth of the section is zero, it is clearly

necessary to provide sufficient longitudinal steel in the section to carry the tension T'_x and this steel should be approximately evenly distributed between top and bottom faces of the beam.

The effect of tension on the reinforcement required at the two sections was investigated under the following conditions:

(i) $M'_x + M_x$ = constant

(ii) M'_x/M_x varied

(iii) T'_x was varied in magnitude.

For each combination, the quantities $(p'f_y/f'_c)$ and (pf_y/f'_c) were calculated. T'_x was applied in two different ways:

(a) at the mid-depth of the beam so that it had no effect on the values of M'_x or M_x

(b) at a distance, e, from the mid-depth such that M'_x and M_x were modified according to:

M'_x (modified) = $M'_x(T'_x = 0) + T'_x \cdot e$

M_x (modified) = $M_x(T'_x = 0) - T_x \cdot e$

Variation of pf_y/f'_c and $p'f_y/f'_c$ with T'_x is shown in Figure 4.3(b).

In the range plotted, both p and p' increase approximately linearly with T'_x for both positions of application.

For no eccentricity, p rises more steeply than p' but the reverse is the case when T_x is applied at .25d above the mid-depth of the negative moment section.

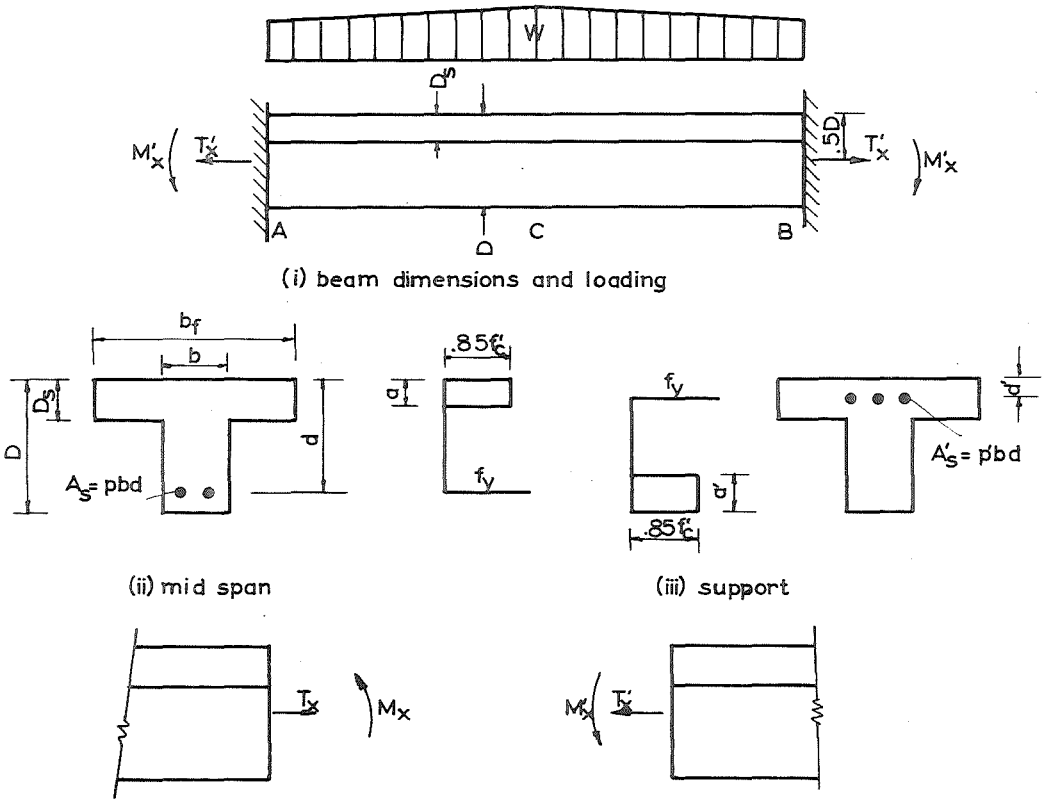
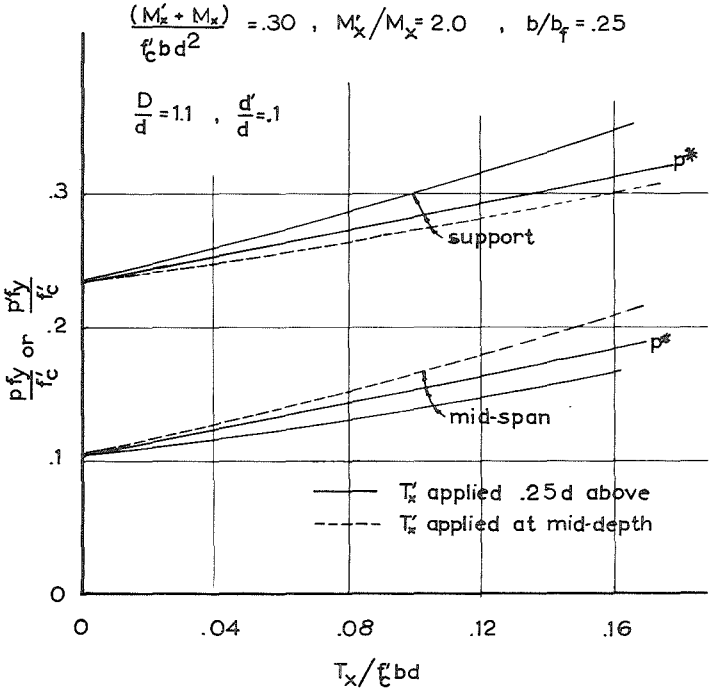


FIGURE 4.3 DESIGN OF BEAMS FOR TENSION



It is interesting to compare the rates of rise of p and p' in this case with their rates of rise when no moment is applied. For this latter case

$$T'_x = 2\ p^* b d f_y \qquad \ldots.(4.16)$$

where p^* is the percentage of steel placed at both the top and bottom of the section.

$$\text{Hence,} \quad \frac{p^* f_y}{f'_c} = \frac{T'_x}{2 f'_c b d} \qquad \ldots.(4.17)$$

The variation of p^* is shown on Figure 4.3(b). Comparison of this with the curves when moment is present shows that the variation of total steel percentage is almost identical but at each of the critical sections the amount of extra steel required follows the variation of p^* rather than the $2p^*$ required at a section on which no moment acts.

Two important conclusions may be drawn from Figure 4.3(b), viz:

(a) The variation of steel percentage with tension is approximately linear.

(b) The rate of increase in the total extra steel required when tension acts on a section is less when moment is also acting. Maximum extra steel is required when no moment acts and is given by Equation 4.17.

Hence the extra steel required in the whole beam to accommodate the tension will be less than that required for

a simple tie member.

4.3 THE EFFECT OF PANEL MEMBRANE ACTION ON TORSION IN SUPPORTING BEAMS

4.3.1 Introduction

In designing an edge panel of a slab and beam floor system by yield line theory the torsional resistance provided by the exterior beams may be put to good use by placing steel in the top of the slab sections along the edge supported by these beams and relying on the full development of hogging yield moments in assessing the ultimate load of the panel. The edge beam would be required to take the torsion induced. The presence of compressive membrane action in the panel may affect the magnitude of this torsion in two ways:

In cases where the edge beams are stiff enough to withstand the lateral forces induced by compressive membrane action forces in the panel, these forces will induce a torsional moment in the beams unless they act through the shear centre of the beam.

In addition, the low torsional stiffness of the edge beams requires large rotations of the slab segments and before these take place, membrane forces may develop in other regions of the slab so that the full development of hogging yield moments along the exterior edges of the panel is not required.

Both of these effects are discussed in the following sections.

4.3.2 Torsion Induced by Membrane Forces at the Edge of the Panel

This case is illustrated by considering the square, isotropically reinforced slab supported by beams around its perimeter as shown in Figure 4.4(a) and (b).

At the ultimate load the hogging yield moment will develop at the beam-slab junction and if im_J and m_J are the enhanced hogging and sagging yield moments, the Johansen load given by the pattern of Figure 4.4(a) is

$$w_J = 24m_J(1+i)/L^2 \qquad \ldots.(4.18)$$

When membrane action causes enhancement of this load to $w_M = F.w_J$ it is reasonable to assume that both m and m' are enhanced by F* giving $m = F^*m_J$ and $m' = iF^*m_J$. Note that F* will normally be greater than F (see Equation 4.5).

The maximum torsional moment in the beams will occur at the sections at the beam junctions, being the sum of the torsional moments induced by the actions of Figure 4.4(b) taken over half the length of the beam. Taking the general case in which membrane action enhances the Johansen load by F, the maximum torque T_m is given by

$$T_m = \sum_{L/2}(sb/2) + \sum_{L/2}(iF^*m_J) - \sum_{L/2}(c'_c - t'_y)(D/2 - D_s/2 - d_u) \qquad \ldots.(4.19)$$

and since $\sum_{L/2}^{(S)} = \frac{w_M L^2}{8}$, m_J and $(c'_c - t'_y)$ are constant along the edge,

$$T_m = .5L(Fw_J Lb/8 + iF^* m_J - (c'_c - t'_y)(D/2 - d_u - D_s/2) \quad ....(4.19a)$$

For no enhancement:

$$im_J = t'_y(D_s/2 - d') + c'_c(D_s/2 - c'_c/1.7f'_c) \quad ....(4.20)$$

Denoting $c'_c/.85f'_c = a$, and noting that $c'_c = t'_y$ for no enhancement, Equation 4.20 becomes:

$$im_j = t'_y(D_s - d' - a/2) \quad ....(4.20(a))$$

For a moment enhancement of F* we have

$$iF^* m_J = t'_y(D_s/2 - d') + c'_c(D_s/2 - a/2) \quad ....(4.21)$$

and substitution for im_j from 4.20(a) gives

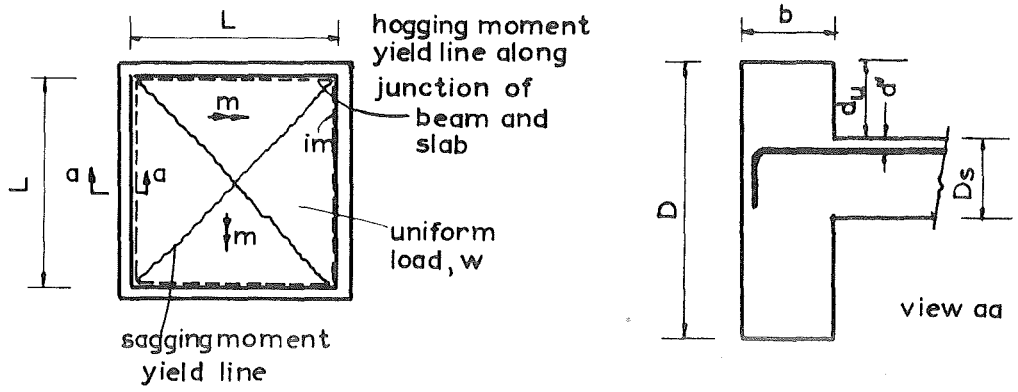
$$c'_c = t'_y(2F^* - 1 - 2d'/D_s(F^* - 1) - F^* a/D_s)/(1 - a/D_s) \quad ....(4.21(a))$$

which may be substituted in 4.19(a). Using Equations 4.18 and 4.21 to express all quantities in terms of im_J and assuming that 'a' does not vary, Equation 4.19(a) becomes

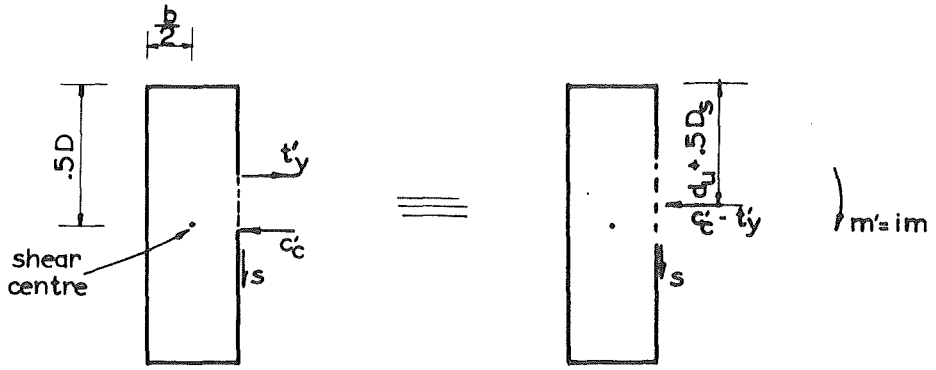
$$T_m = Fim_J \frac{L}{2}\left[\frac{F^*}{F} + 3\left(\frac{b}{L}\right) \cdot \frac{(1+i)}{i} - \frac{2(F^*-1)}{F}\frac{(D/2D_s - \frac{1}{2} - du/D_s)}{(1 - a/D_s)}\right] \quad ....(4.22)$$

$$= iFm_J L/2 \quad (1 + A + B) \quad ....(4.22(a))$$

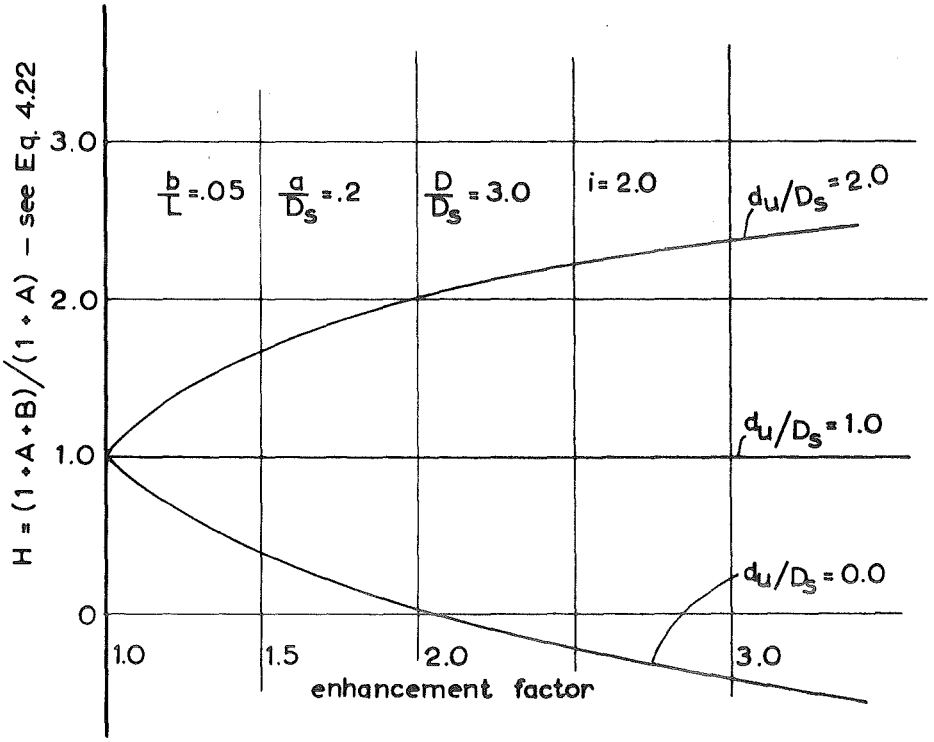
Now, without enhancement (F = 1), B = 0 and the maximum



(a) slab, and beam junction dimensions



(b) actions per unit length of beam



(c) effect of membrane action on maximum torque

FIGURE 4.4 TORSION IN EDGE BEAMS

torque is $im_J\ L/2(1+A)$ as would normally be the case. However, once membrane action enhancement takes place the position of the slab centroid with respect to the shear centre of the beam becomes important. This effect is taken into account by the term B and the magnitude of this effect may be conveniently determined by calculating the ratio, $H = (1+A+B):(1+A)$, for various F values and beam-slab junctions. The results of these calculations for a typical beam are given below.

Calculation of the Ratio H

Example beam.

$$\frac{b}{L} = .05, \quad \frac{a}{2D_s} = .1, \quad i = 2.0, \quad \frac{D}{D_s} = 3.0$$

Assuming $F^* = F$.

Therefore $1+A = 1.225$, $1+A+B = 1.225 - 2.5\frac{(F-1)}{F}(1-\frac{d_u}{D_s})$

Load Enhancement Factor F	Values of H = (1+A+B)/(1+A)		
	$d_u/D_s=0$	$d_u/D_s=1.0$	$d_u/D_s=2.0$
1.0	1.00	1.00	1.00
1.25	.59	1.00	1.41
1.50	.32	1.00	1.68
2.0	-.02	1.00	2.02
2.5	-.23	1.00	2.23
∞	-1.05	1.00	3.05

These values are plotted on Figure 4.4(c).

The effect of change in d_u/D_s is understandably large and changes sign when the mid-depth of the slab coincides with the mid-depth of the beam. The reduction in maximum torsion is remarkable when the top of the slab is flush with the top of the beam.

4.3.3 Conclusion

Design of a slab such as in Figure 4.4 to include the effects of membrane action would require the beams to be designed for a laterally outward load in addition to the normal vertical load. Placement of the slab flush with the beam at the top would offset this additional requirement by reducing the torsion induced in the beams. In the more general case in which lateral restraint is provided by surrounding panels and the supporting beams the effect on the beams would not be as great. The surrounding panels would take most of the lateral force and the nett lateral force on the beam would be smaller. Less effect on lateral bending and torsion would result.

Nevertheless, the high sensitivity of the maximum torque, even at low enhancement factors, indicates that consideration of this behaviour is important in many cases.

4.3.4 Suppression of Hogging Yield Moment Development Along Exterior Edges of Panels in Which Membrane Action is Present

In designing edge panels to develop full hogging

moments along the exterior edges, only the torsional strength of the edge beam need be sufficient for this to occur ultimately. In the case of panels which may develop membrane compressive forces which enhance the load capacity of the panel, the full development of the exterior edge hogging yield moments may not be required. In the test to destruction on a model nine-panel reinforced concrete slab and beam floor described in Chapter 9, the steel strains along the exterior edges of the edge panels were well below yield values at the predicted ultimate load and a reduction in the edge beam torsion was evident. The presence of compressive membrane forces normal to the edge would account for the reduction in torsion, and, because membrane action is not purely an ultimate phenomenon, the value of the restraining moment could have been enhanced above that which the level of steel strains would normally imply.

However, the capacity of the edge beams to resist lateral force was not high and an alternative mechanism was sought.

Recently,[39] it has been reported that the torsional stiffness of a reinforced concrete beam reduces remarkably when cracking occurs. It is clear then that large twisting deformations of the beam would be required before the full yield moment could be developed and the slab element would have to rotate even further to create the differential movement necessary for the development of the yield moment.

No attempt was made to analyse this case but the observed behaviour during the test suggested that membrane action in other regions of the edge panels provided assistance in carrying the load before sufficient slab deformation could occur to develop the hogging yield moments along the exterior edges. Torsional moments in the edge beams computed on the basis of the full development of these hogging yield moments could thus considerably overestimate the true values.

4.4 DISCUSSION AND CONCLUSION

It is clear that membrane action in panels will affect the flexural and torsional steel requirements of beams.

The method of determining beam tensions is a simplification but values of beam section actions resulting provide adequate strength and a realistic distribution of moment between mid-span and support sections.

The equations derived to determine the flexural reinforcement at critical sections of a T-beam subject to moment and axial tension require some qualification in that at sections of the beam at which the moment is zero, a sufficient amount of longitudinal steel must be placed to take the tension. Furthermore, at the critical sections it is necessary to check that the neutral axis lies within the section.

Because of the likely adverse effect of beam deform-

ations on the development of panel membrane action it would be wise to ensure the beam collapse mechanisms do not occur before the panel mechanism.

The effect of compressive membrane action on the torsion induced in the supporting beams is clearly considerable, and worthy of consideration in design. For the case in which membrane forces acting normal to the edge beam reduce the torsion, any advantage so gained could be offset by any extra provision required for biaxial bending of the beams.

However, in cases where membrane action may exist in other regions of the edge panels it is likely that the torsion for which the edge beams would normally be designed will not be attained. This latter effect, or even the combination of the two effects discussed could provide an instance in which the neglect of membrane action leads to the overdesign of edge beams for torsion.

CHAPTER 5

STIFFNESS OF SURROUNDS FOR SQUARE SLABS

5.1 INTRODUCTION AND SUMMARY

The degree to which compressive membrane action enhances the load carrying capacity of a reinforced concrete slab depends principally on the lateral stiffness of the elements providing restraint against outward movement of the slab edges.

For interior panels of a multi-panel slab and beam floor, this restraint is provided by the panels surrounding the one in question. Thus when the interior panel exhibits compressive membrane action, the surrounding panels are subject to in-plane forces. The surrounding elements may therefore be considered as a flat slab with in-plane loads applied normal to the edges of a central hole which corresponds in size to the panel exhibiting compressive membrane action.

In order to obtain some measure of the variation of surround stiffness with the size of the outer panels, slabs of elastic, isotropic, homogeneous materials were analysed. The study was restricted to the consideration of a square slab with a square central hole.

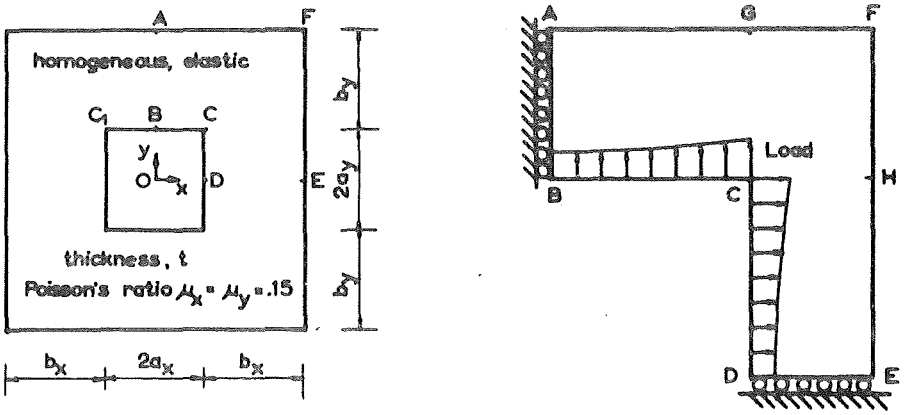
A library computer programme employing the finite element method for the solution of plane stress problems was used to calculate the deflections of the loaded edges and the stresses within the surround.

Because the rigorous plane stress analysis required large computational effort an alternative method of computing the edge deflections was sought. Consideration of each edge of the surround as a deep beam proved very satisfactory in this respect. The rapid computation of edge displacements would permit extension of theories such as that due to Park[11] to include interaction of the edges of surround and slab.

5.2 METHOD OF ANALYSIS AND CASES CONSIDERED

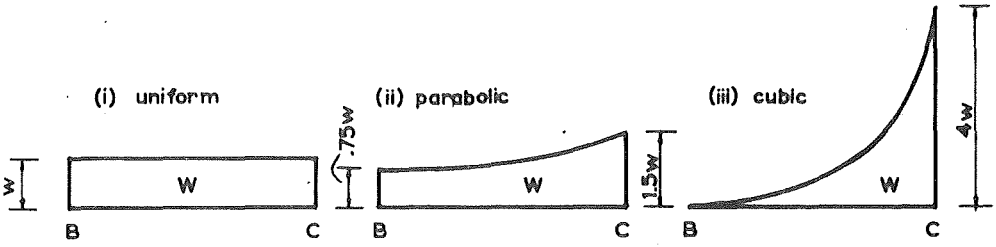
The dimensions and properties of the slab considered in this study are shown in Figure 5.1(a). Due to symmetry it was necessary to analyse only the portion ABCDEF with boundary conditions as in Figure 5.1(b). For each surround shape, three separate load distributions were applied to the edges, BC and CD, each of the same total load. The shapes of these distributions (see Figure 5.1(c)) were chosen as representative of the possible distributions of membrane forces along the edges of a square interior slab.

Analysis was carried out using an existing computer programme for solving plane stress problems by the finite element method based on a quadratic strain triangle[21].



(a) Plate properties

(b) Element analysed



(c) Load distributions

FIGURE 5.1 SLAB SURROUND ANALYSED

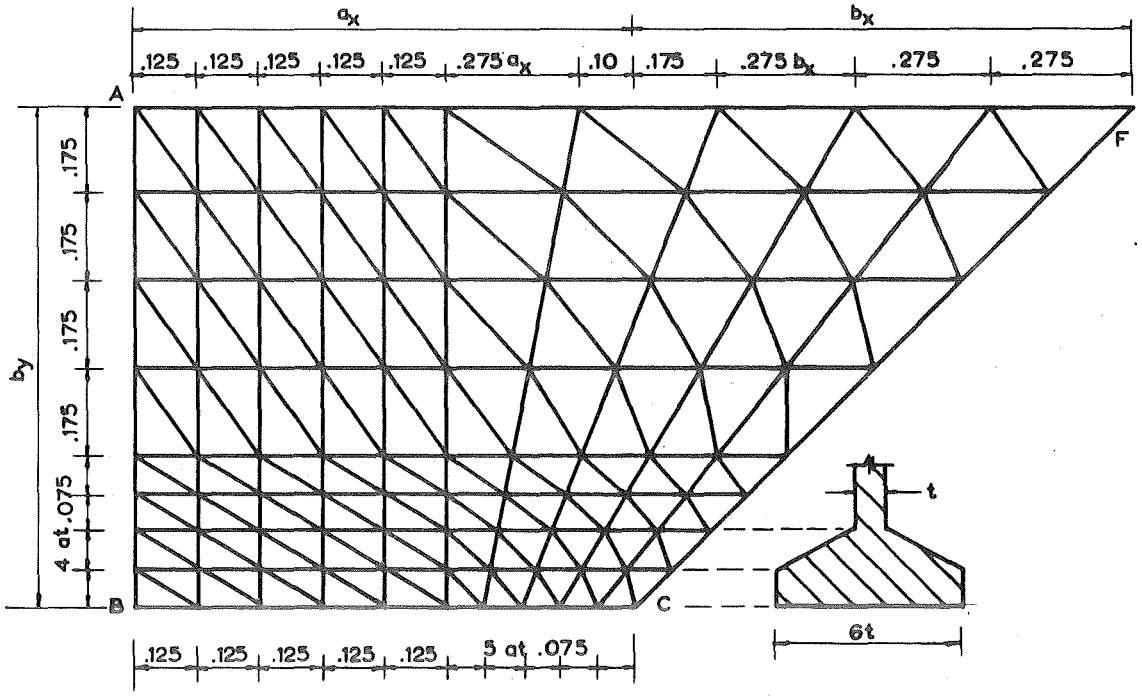


FIGURE 5.2 FINITE ELEMENT MESH

Each of the portions ABCF and CDEF was divided into 160 triangular elements as in Figure 5.2. Loads were applied to nodal points in the y direction along BC and in the x direction along CD.

The study was limited to cases in which $a_x = a_y$ and $b_x = b_y$. In the first series, the slab was of uniform thickness throughout and four cases were considered with a_x/b_x taking the values: .5, 1.0, 1.5, 3.0.

To investigate the effect of supporting beams, the case of $a_x/b_x = 1.5$ was analysed with a thick band along BC and CD. The dimensions of this band are shown in Figure 5.2. The symmetrical shape was required because a two-dimensional stress system was being analysed, and the tapering thickness across the second row of elements was necessary to avoid stress discontinuity at the element boundaries.

For each surround under each load the following quantities were determined at each nodal point.

(i) The normal stresses and strains in the x and y direction.

(ii) The shear stress and strain in the x or y direction.

(iii) The maximum and minimum principal stresses.

(iv) The maximum shear stress.

(v) Displacements in the x and y direction.

For reasons outlined under 5.1, displacements of the

loaded edges were of particular interest in the context of membrane action and it is these that receive greatest attention in the following sections.

5.3 DISPLACEMENTS OF THE LOADED EDGES

Although stress concentration at the re-entrant corner, B, cast doubt on the accuracy of computed stresses near this point, the use of small elements in this region ensured that its effect on stresses at other points was very small, and the effect on deflections even less.

In Figure 5.3 the displacements in the y direction of the edge BC of the surrounds are shown. The quantity, $n = \frac{\Delta tE}{W}$, expresses this movement in non-dimensional form. Δ = deflection of the edge, t = thickness of slab, E = modulus of elasticity of slab material, W = total load applied normal to the edge BC (= one half of total load applied to one edge of the interior hole).

Hence the deflection, Δ, of the edge may be obtained from

$$\Delta = nW/tE \qquad \ldots.(5.1)$$

Features to note in Figure 5.3 are

(a) The small difference between load cases (i) and (ii).

(b) The large difference between load case (iii) and load case (i).

(c) The ratio of maximum deflection (at B) to deflection at C is greater for low values of surround width.

(d) Deflections along the edge are remarkably constant for load case (iii), especially for $a_x/b_x = 1.0$ and 1.5.

(e) The maximum deflection falls off rapidly as a_x/b_x is decreased from 3.0, but the change in maximum deflection when a_x/b_x is decreased from 1.0 to 0.5 is very small.

Figure 5.4 shows that load case (iii) has less sensitivity to change in a_x/b_x than load case (i) and gives a clear indication that decrease in a_x/b_x lower than 1.0 brings little increase in surround stiffness. The effect of increasing the surround width is further lessened when the results of Chapter 3 are recalled, viz., an increase in surround stiffness does not produce a proportionate increase in the enhancement factor.

(f) The effect of including the thicker edge beam on the maximum deflection is plotted in Figure 5.4.

In both load case (i) and load case (iii) its inclusion is equivalent to increasing the surround width. However, this effective increase in width was less than could have been achieved by using the same amount of extra material to increase the surround width directly. This situation

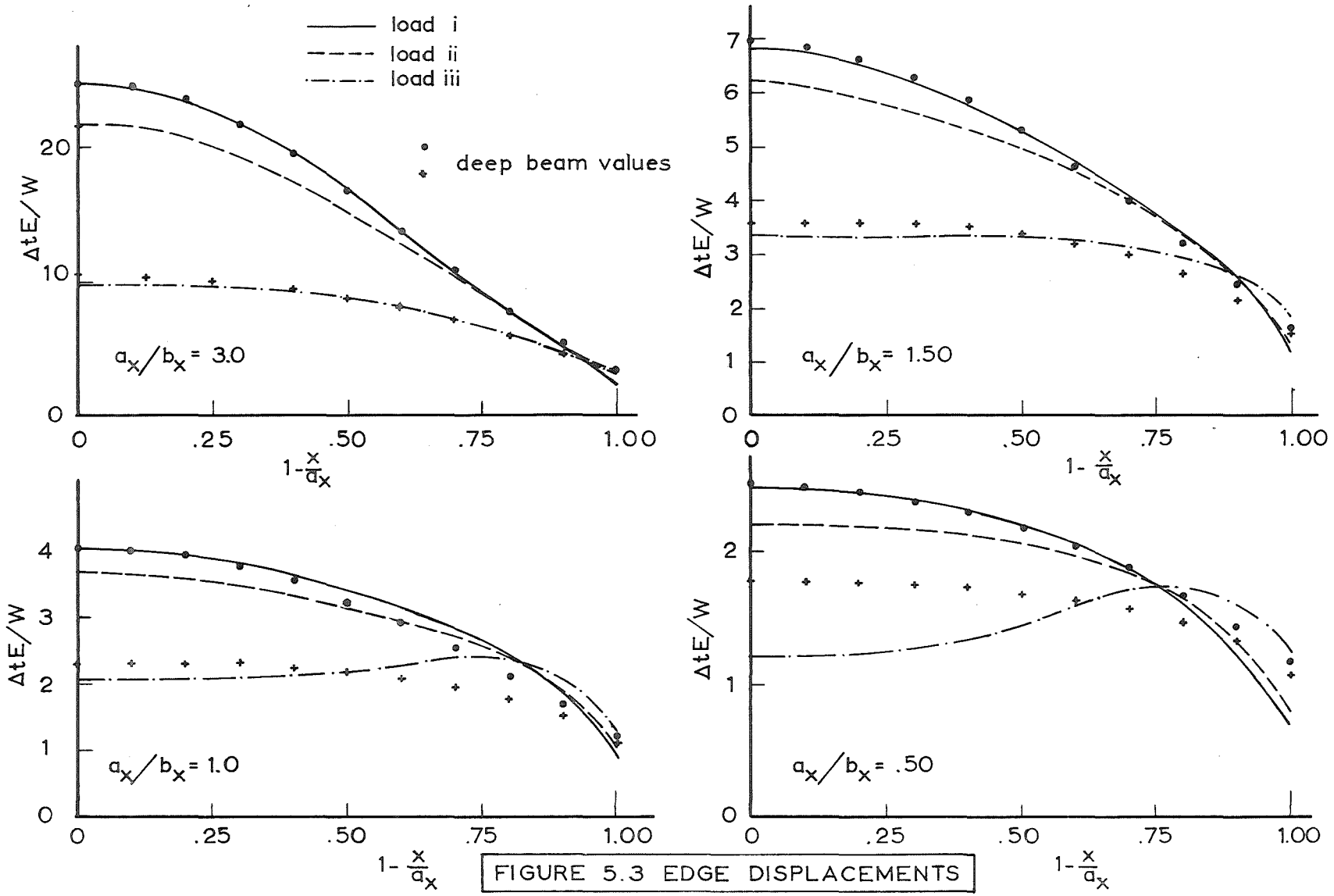


FIGURE 5.3 EDGE DISPLACEMENTS

is likely to reverse in cases of very wide surrounds where the contribution of the extension of the side CD is proportionately greater.

5.4 STRESSES IN THE SURROUND

Because regions of high stress in reinforced concrete will crack, knowledge of the distribution of stress within the surround as computed for an elastic, homogeneous, isotropic material is of limited value. However, knowledge of the regions of high stress provides a means by which the surrounding panels may be adequately and efficiently reinforced to resist the stresses induced by membrane forces acting in the central panel.

In Figure 5.5(a), contours of the direct stress in the y direction are plotted for load case (i) on a surround of uniform thickness and with $a_x/b_x = 1.0$. The stress contour values relate to the intensity of the uniform pressure applied to BC and CD.

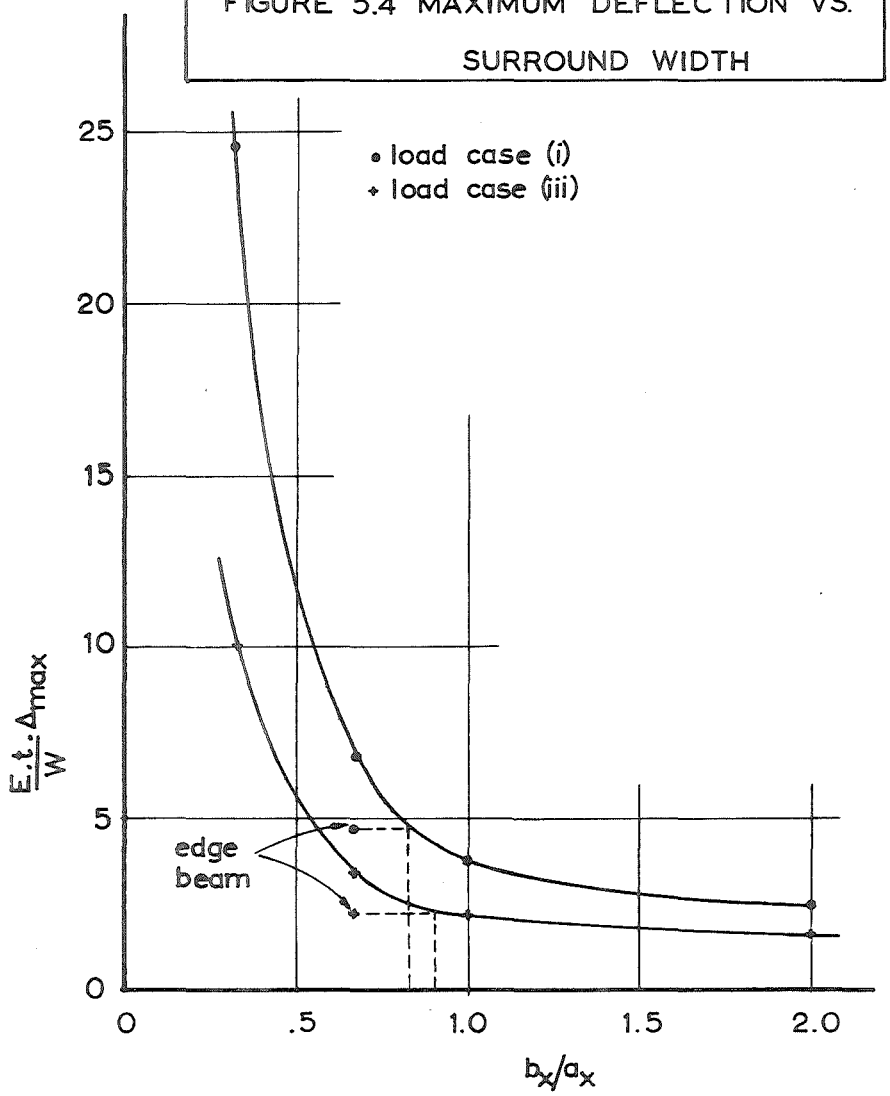
Figure 5.5(b) shows the contours of the shear stress along the face of a section taken parallel to either the x or y axis. Stress contours again refer to the intensity of applied pressure.

5.5 DEEP BEAM APPROXIMATION

5.5.1 Introduction

Detailed plane stress analysis is not straightforward

FIGURE 5.4 MAXIMUM DEFLECTION VS. SURROUND WIDTH



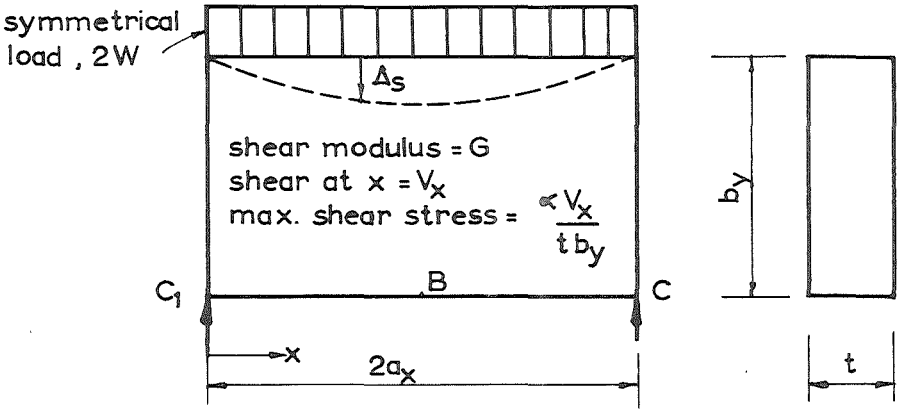


FIGURE 5.6 SHEAR DEFLECTION

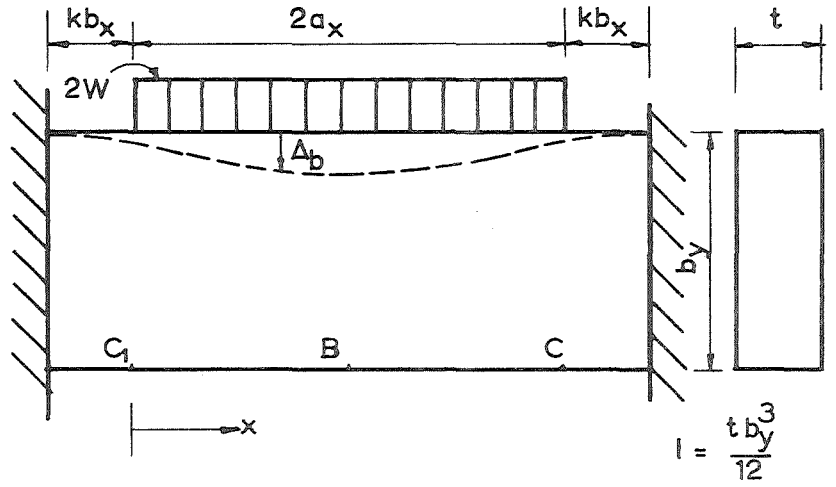
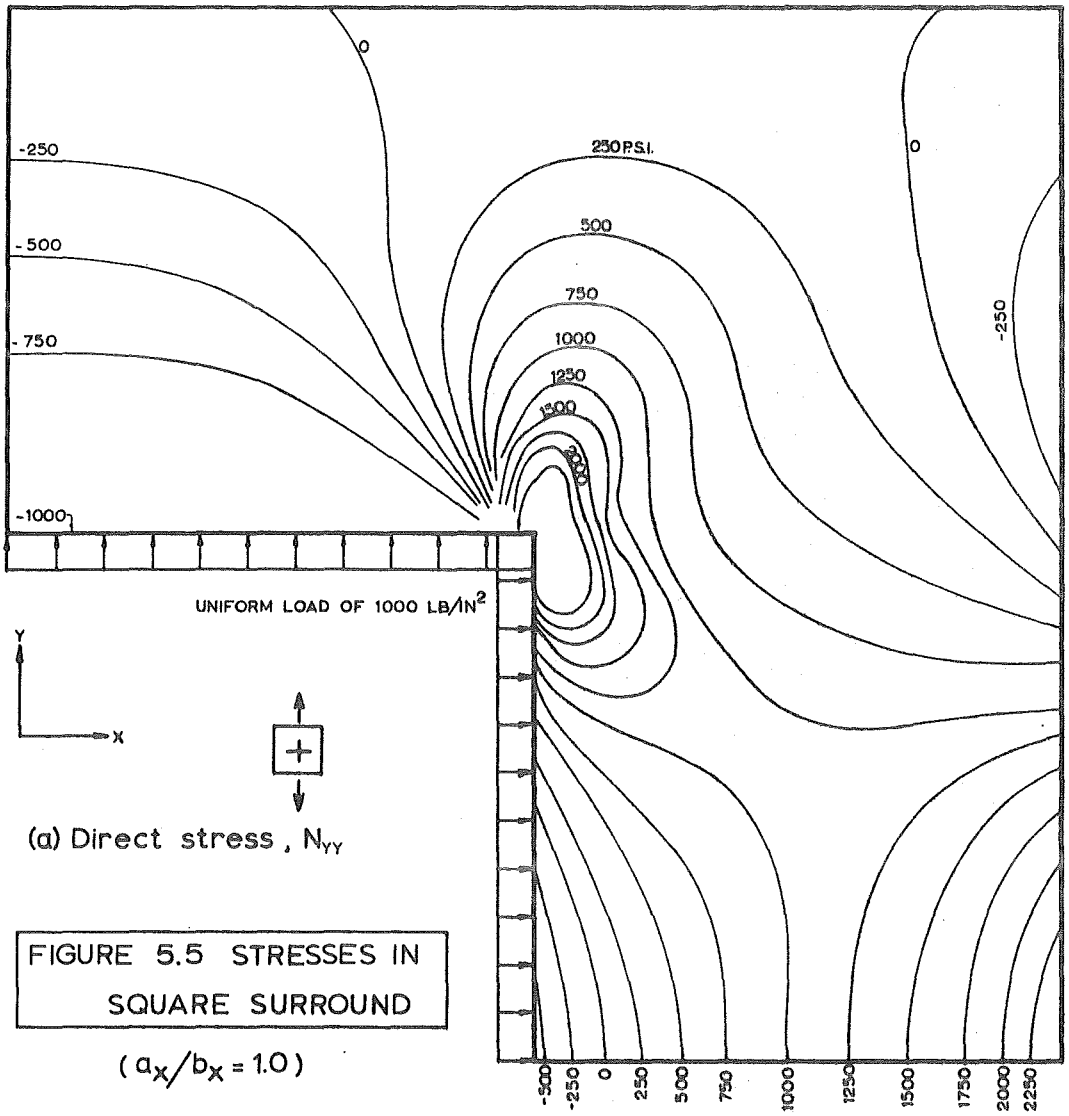


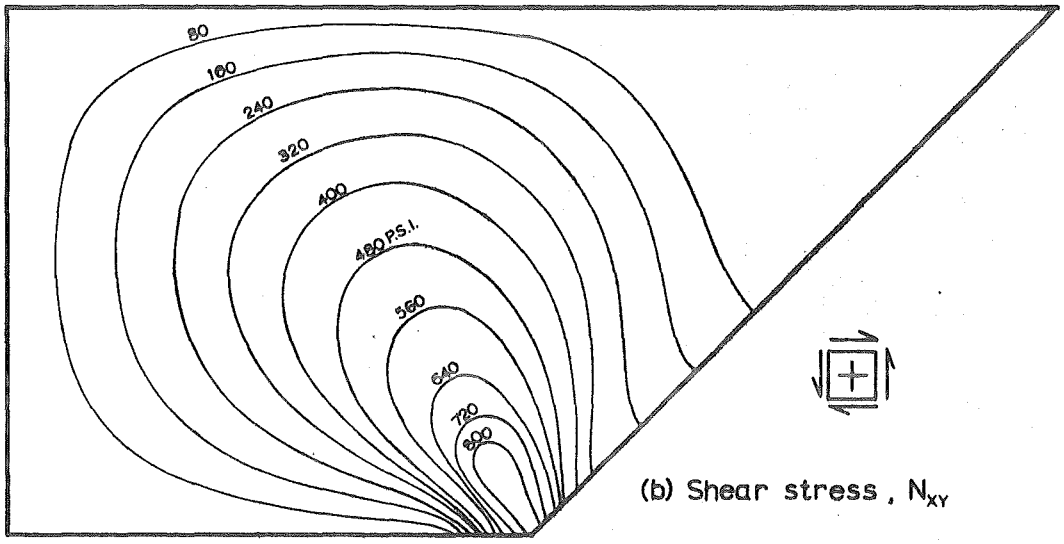
FIGURE 5.7 FLEXURAL DEFLECTION



(a) Direct stress , N_{YY}

FIGURE 5.5 STRESSES IN SQUARE SURROUND

$(a_X/b_X = 1.0)$



(b) Shear stress , N_{XY}

and requires considerable computational effort. The interest in this problem in respect to membrane action in reinforced concrete slabs is chiefly in the deflection of the loaded edges. In membrane action theories such as that due to Park[11], the edges of the slab are assumed to move out a uniform distance regardless of the variation of load intensity along the edge. A possible means of refining this would be to account for the interaction of load intensity and lateral deflection at the restraining edge of the slab. Such a method would require iteration of the load intensity until outward movements of the restraining surround were compatible with those of the slab edge.

A quick and reasonably accurate method of determining the surround deflection profile would therefore be extremely advantageous.

On the basis of the results of the plane stress analysis, an "equivalent" deep beam was found which gave the same maximum deflections and a similar deflected shape. This was done by considering deformation of the surround edge due to axial extension of the sides, shear deformations in the clear span, and flexural deformation of a beam of length slightly greater than the clear span.

5.5.2 Deep Beam Model

The total deformation of the side C_1BC (Figures 5.1 and 5.6) of the surround was assumed to be made up of:
(i) axial extension of the portion CDEH (Figure 5.3),

(ii) shear deformation of the portion ABDG as if it were half of a simply supported beam of span $2a_x$, and (iii) flexural deformation of a fixed ended beam of span $2(a_x + kb_x)$. These are described in detail below.

(i) Axial Extension

This was computed assuming that CDEH was a tie rod. Force in tie rod = W, area of cross section = $t\ b_x$, length = a_y

$$\therefore \text{ Extension } \Delta_e = \frac{W.a_y}{t\ b_x.E} \qquad \ldots.(5.2)$$

A useful non-dimensional form for the deflection is

$$\frac{\Delta_e.Et}{W} = \frac{a_y}{b_x} \qquad \ldots.(5.3)$$

This extension applied to the whole profile of BC, regardless of the distribution of the load, W along it.

(ii) Shear Deformation

For a simply supported beam as in Figure 5.6 the shear displacement, Δ_s is given by

$$\frac{d\Delta_s}{dx} = \frac{\alpha V_x}{tb_yG}$$

Two cases of load were considered:

(a) uniform

(b) cubic - as in load case (iii) (Figure 5.1).

(i) Uniform load

This gives

$$\Delta_s . Et/W = (\propto E/2G)(a_x/b_y)(x/a_x)(2-x/a_x) \quad ....(5.4)$$

(ii) Cubic Variation as in Figure 5.1(c)

$$\frac{\Delta_s tE}{W} = \frac{\propto E a_x}{G\ b_y}(X-2X^2+2X^3-X^4+X^5/5) \quad ....(5.5)$$

where $X = x/a_x$

(iii) Bending Deflection

The model was as shown in Figure 5.7.

Deflections resulting were as follows:

(a) Uniform Load

$$\Delta_b \frac{tE}{W} = \left(\frac{a_x}{b_y}\right)^3 \left\{ \frac{\left[2+6\left(\frac{kb_x}{a_x}\right)+3\left(\frac{kb_x}{a_x}\right)^2\right]\left[\frac{x}{a_x}+\frac{kb_x}{a_x}\right]^2}{\left(1+\frac{kb_x}{a_x}\right)} - 2\left[\left(\frac{x}{a_x}\right)+\left(\frac{kb_x}{a_x}\right)\right]^3 + \frac{1}{2}\left(\frac{x}{a_x}\right)^4 \right\} \quad ....(5.6)$$

(b) Cubic Distribution

$$\Delta_b \frac{tE}{W} = \left(\frac{a_x}{b_y}\right)^3 \left\{ \frac{\left[1+6\left(\frac{kb_x}{a_x}\right)+3\left(\frac{kb_x}{a_x}\right)^2\right]\left[\frac{x}{a_x}+\frac{kb_x}{a_x}\right]^2}{\left(1+\frac{kb_x}{a_x}\right)} - 2\left(\frac{x}{a_x}+\frac{kb_x}{a_x}\right)^3 + \left(\frac{x}{a_x}\right)^4\left[2-\frac{6}{5}\left(\frac{x}{a_x}\right)+\frac{2}{5}\left(\frac{x}{a_x}\right)^2-\frac{2}{35}\left(\frac{x}{a_x}\right)^3\right] \right\} \quad ....(5.7)$$

5.5.3 Determination of k and Deflected Shapes

For the uniform load case, the maximum deflection of the edge of the surround for each surround shape was

computed using plane stress analysis.

Comparison of the two maximum deflections using Equation 5.6 yielded a cubic equation in k which was solved for each surround shape. For a square hole in the centre of a square slab, the surround shape was defined by the value of b_x/a_x. For the four values of b_x/a_x the variation of k with b_x/a_x was close to parabolic and k was assumed to be given by

$$k = A(b_x/a_x)^2 + B(b_x/a_x) + C$$

Least squares analysis of the four values gave

$$k = .0795(b_x/a_x)^2 + .0795(b_x/a_x) + .126 \qquad ....(5.8)$$

This value of k was taken to apply for any symmetrical load distribution and was used in Equations 5.6 and 5.7 to obtain the deflected shapes of the equivalent deep beam. The shapes were calculated as the sum of deflections given by Equations 5.3, 5.4 or 5.5, and 5.6 or 5.7, and are plotted on Figure 5.3 for comparison with the plane stress analysis solutions.

5.6 CONCLUSIONS

In spite of the assumption that the material was elastic, isotropic and homogeneous, the results of the above analysis provide a valuable insight into the problem of determining the outward movement of the edges of a

reinforced concrete slab restrained laterally at its edges by a rectangular surrounding medium.

The following conclusions were drawn:

(i) Effect of Increase in Surround Width

Figure 5.4 shows clearly the effect of increase in b_x/a_x on the stiffness of the surround. For ratios of b_x/a_x greater than 1.0 very little gain will show up in the enhancement of the load capacity of the central panel. Increase of the ratio b_x/a_x above 2.0 may be assumed not to contribute to surround stiffness. This will be especially so when the effects of creep, shrinkage, cracking and vertical deflection of the central panel serve to reduce the effective surround stiffness

(ii) Deep Beam Approximation

The lateral deformations as computed for an equivalent deep beam agree well with the more rigorously derived values. The equivalent deep beam could be used with good effect in calculating outward movements of the surround in refining Park's theory[11] for the determination of the ultimate loads of laterally restrained reinforced concrete slabs. It is of interest to note that a steel surround of relatively low b_x/a_x and large thickness, t, would provide a stiff surround and would be well modelled by the deep beam approximation.

(iii) Stresses

The re-entrant corner caused a large increase in

stress and the region near it should be reinforced in both directions.

Large tensile stresses occur at the outside edge at the mid-span of the side of the surround and could well require special reinforcement.

An appreciable compressive stress normal to the "span" of the surround is developed, i.e., the panels adjacent to the central one are subject to in-plane compression in one direction which could enhance the transverse load capacity.

CHAPTER 6

DESIGN AND CONSTRUCTION OF MODEL SLAB AND BEAM FLOOR

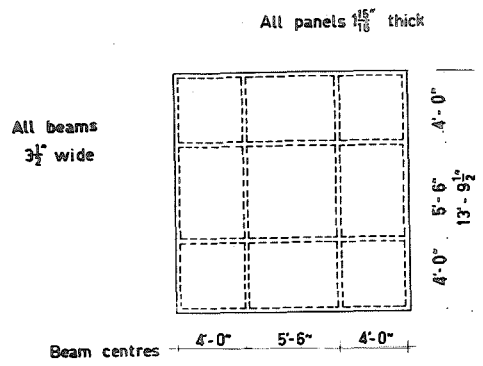
6.1 INTRODUCTION

This chapter describes the design and construction of a quarter scale, nine panel reinforced concrete slab and beam floor. Figure 6.1 is a structural drawing of the slab.

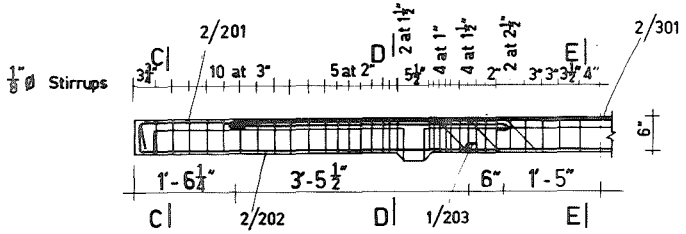
Both the slab itself and the testing programme were designed to investigate the effects of membrane action in a representative floor system. Compressive membrane action enhancement was allowed for in the centre and centre-edge panels. The appropriate beam spans were designed to accommodate the tension induced in them by the compressive forces in the plane of the panels Particular note was taken of the following aspects of the behaviour of the floor under load:

(a) The general effect of compressive membrane action on the behaviour of panels and beams and on the floor system as a whole.

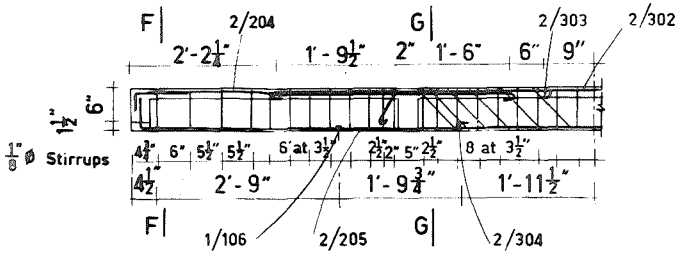
(b) The relative contributions of the surrounding



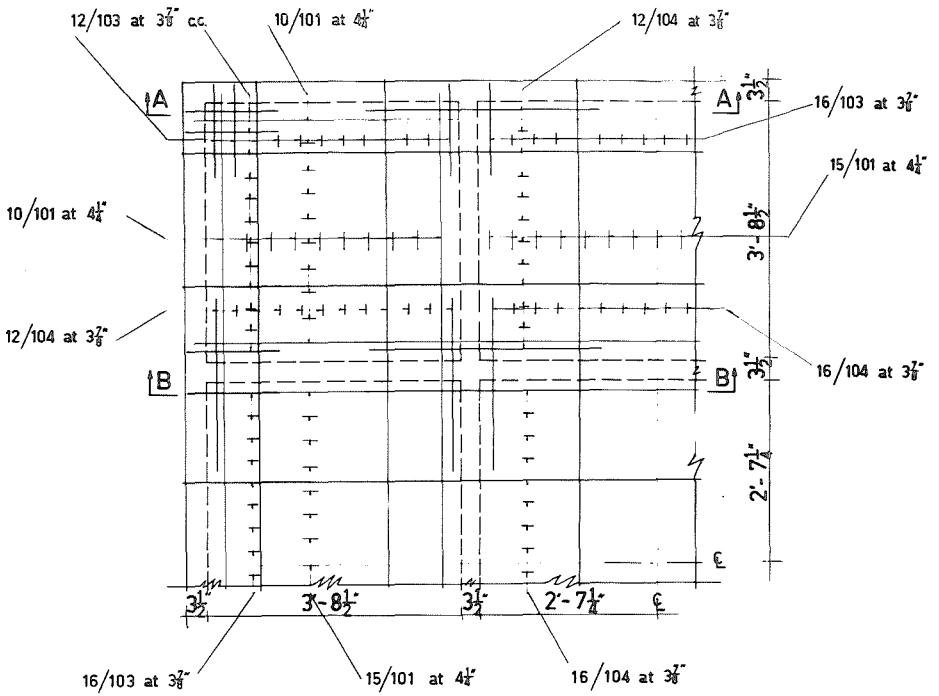
PLAN OF FLOOR



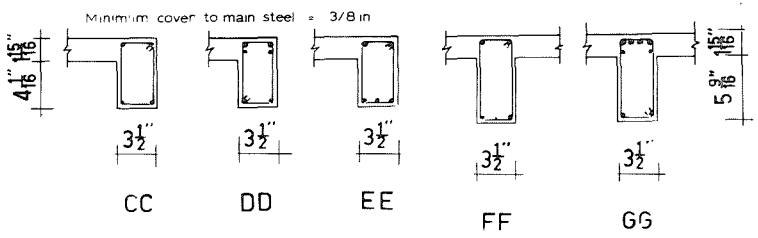
VIEW AA - EXTERIOR BEAM

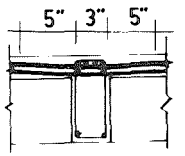


VIEW BB - INTERIOR BEAM



PART PLAN SHOWING SLAB REINFORCEMENT





INTERIOR BEAM JUNCTION

FIGURE 6.1 QUARTER-SCALE, REINFORCED CONCRETE SLAB AND BEAM FLOOR

beams and panels in providing the lateral restraint necessary for load enhancement by compressive membrane action.

(c) The magnitude and distribution of in-plane forces in the slab panels, especially the centre panel.

(d) The magnitude of the tensions induced in the beams and the effect of this tension on the beam behaviour.

(e) The level of steel strains, especially in the beams, as a check on the adequacy of the steel provided in order that a more realistic steel volume comparison could be made between the design method used and design by conventional yield line theory.

Although the floor was to be a quarter scale model of a full size floor, no particular floor was modelled and dimensions used in design were those of the model floor. The design followed procedures as for a full size structure except for cover requirements which were scaled down from Code of Practice values.

For a model in which all dimensions of all components are scaled by the same factor, the behaviour is theoretically the same as that of the prototype and in the case of a floor, both model and prototype have the same load capacity per unit area. This prediction is based on the

assumption that the component materials of steel and concrete exhibit the same strength characteristics regardless of the absolute size of the model. That this assumption may not hold was shown by Litle and Paparoni[28], who reported greater strength with reduction in size. However, the order of the effect of reduction of absolute size was not significant in models for which the ratio of prototype to model lengths was not large. Alami and Ferguson[23] have reported satisfactory results for beams with scale factors up to 4.5 with the qualifications that cracking is only approximately modelled and that for beams failing primarily as a result of bond failure, reliable results cannot be expected. Tests on quarter scale model floors at the University of Illinois[24,25,26] revealed no significant small scale effects and small mortar beams tested at the Portland Cement Association Laboratories[38] further illustrated that modelling to quarter scale produced a satisfactory representation of prototype behaviour.

The modelling of crack behaviour is difficult, for in addition to the small scale influence reported by Alami and Ferguson, prediction of crack widths in full size structures is difficult in itself.

Investigations into the prediction of crack widths and the effects of scale factor[31,27,29,30,32] have resulted in the proposal of several different formulae to predict crack widths. Some of these imply that the crack

widths will vary according to the scale factor while others imply variation according to the square root of the scale factor. The results reported by Kaar[31] suggest that the actual variation lies between these limits.

6.2 GENERAL DESIGN BASIS AND SPECIFICATIONS

The overall size of the model floor was limited by the size of laboratory facilities and the proposed placement of strain gauges on the slab reinforcement imposed a lower limit on the diameter of the reinforcement rods used as panel reinforcement. These two factors permitted a rough assessment of the load carrying capacity of the floor to be made. With the slab dimensions as estimated, the effect of membrane action in enhancing the load carrying capacity was assessed using the theory due to Park[11, 12,13].

On the basis of preliminary investigations it was decided to design the floor to have an ultimate load of 800 psf. Even at this load it was found that, with the allowance for compressive membrane action, panel reinforcement contents were close to the minimum required by the British Code of Practice. This resulted in the placement of the minimum allowable reinforcement for bottom steel in both directions of all panels. The ratio of hogging to sagging moment reinforcement was to be constant for all panels. Enhancement of the centre panel was to be

sufficient to double its Johansen load. In the corner panels, no membrane action enhancement was to be allowed for. Thus the uniform panel thickness and the regularity of the panel reinforcement made it possible to determine the plan dimensions of the corner and centre panels. Plan dimensions and the required enhancement of the centre-edge panels were thus defined.

Limit design was used for the design of the beams. The presence of tensions in some spans required the provision of additional longitudinal steel and a re-assessment of the shear capacity.

All slab panels having one or two edges supported by an exterior beam were designed on the assumption that full hogging yield moments would be developed along these edges.

Accordingly, the exterior beams were to be designed to carry the torsional moments induced. Torsion induced in the interior beams during pattern loading was not designed for specifically.

Park's equations[11] were used to assess the membrane action enhancement of the panels, the Australian Code of Practice[33] was used for torsional design and the British Code of Practice for Reinforced Concrete - CP114[35] used for minimum panel reinforcement. The American Concrete Institute Building Code ACI 318 - 63 was used for all other aspects of design with the exception that a load factor of

2.0 was used for both dead and live load and the capacity reduction factor, ϕ, was modified to 1.0 for bending and .945 for shear. This was equivalent to using ACI 318-63 with a load factor of 1.8, not 1.5 on dead load.

The following specifications as to loading and material properties resulted:

(a) Loading

Design Service Load = 400 psf consisting of 100 psf prototype dead load plus 300 psf live load.

Ultimate Load = 800 psf = 2.0 x Service Load.

Loading patterns with full live load on alternate panels were to be considered. Loading of the centre panel alone or the outer panels only to full live load was to be considered.

The capacity of the floor to resist "line" loads was to be checked but the floor was not designed to take full design live load in this configuration.

Figure 6.2(a) shows the notation used to describe the beams and panels of the floor and Figure 6.2(b) shows the loading patterns considered in design.

(b) Membrane Action Enhancement

The ratios of ultimate load to Johansen load for the panels were to be:

Centre panel	2.0
Corner panel	1.0
Centre-edge panel	About 1.3

(c) Concrete

Cylinder strength to be 4200 psi.

Cube strength to be 5300 psi.

(d) Steel

	Bar Diameter	Yield Force (lb)	Yield Stress (psi)
Flexural:	$\frac{1}{8}$"	640	52,000
	$\frac{1}{4}$"	2040	42,000
	$\frac{3}{8}$"	4750	43,000
Stirrups:	$\frac{1}{8}$"	530	

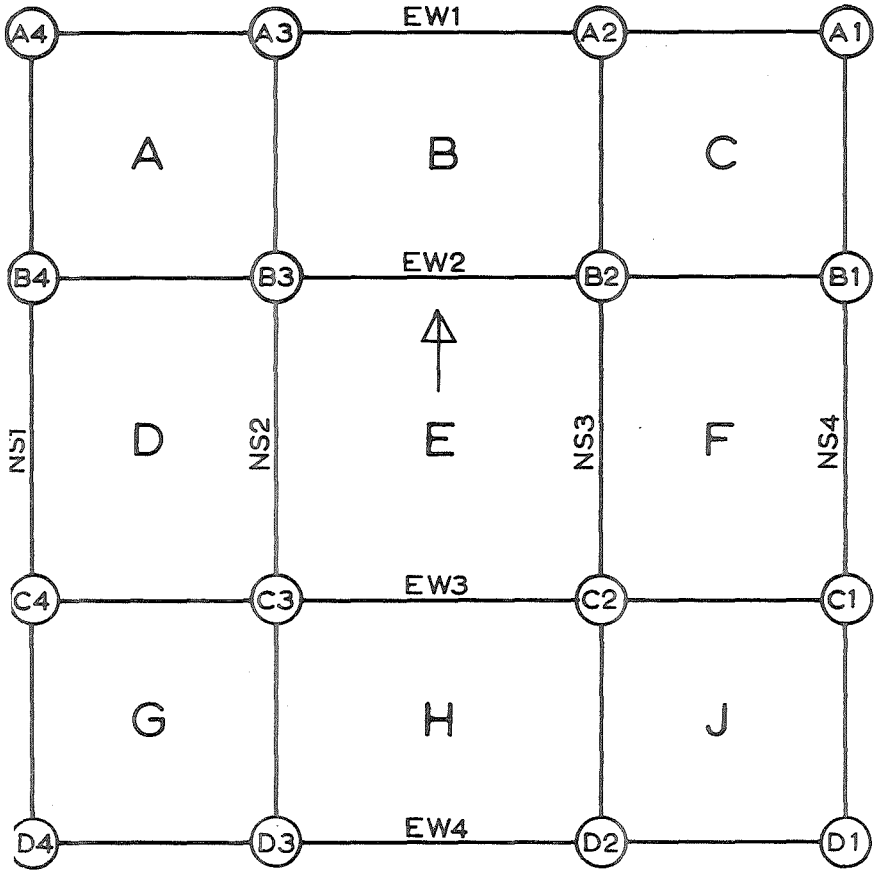
The design procedure followed that outlined above. A summary of the specific methods and results follows in the next two sections, 6.3 and 6.4. A more detailed description is given in Appendix A.

6.3 DESIGN OF FLOOR PANELS

6.3.1 Design Criteria

In order to keep the load capacity of the floor down to realistic proportions, the bottom reinforcement in the slab panels was designed so that the $\frac{1}{8}$" diameter bars available provided the minimum allowable reinforcement when placed at the maximum allowable spacing. British Code requirements for minimum steel were adopted in preference to the more stringent ACI requirements. The above combination enabled the determination of a suitable slab thickness.

FIGURE 6.2(a) SLAB LAYOUT NOTATION



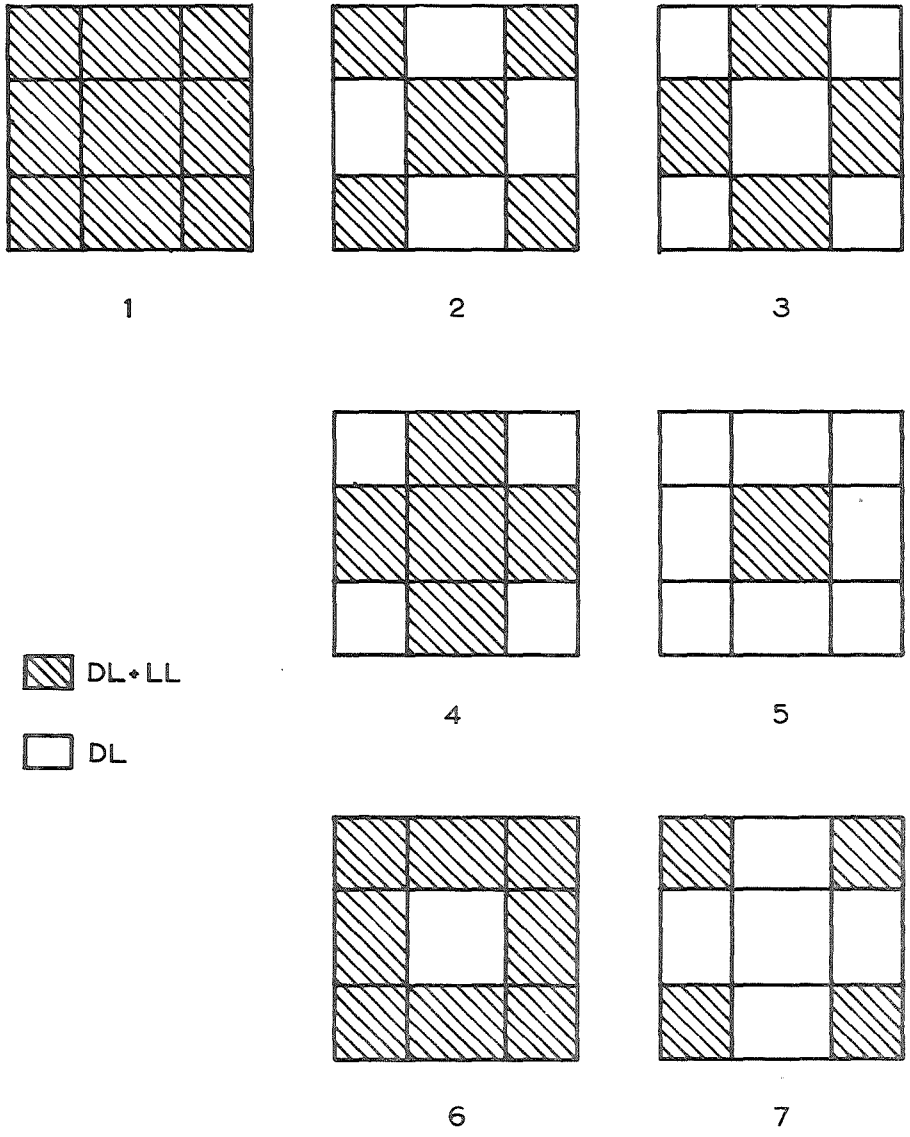


FIGURE 6.2(b) LOAD PATTERNS CONSIDERED

The specification of an enhancement factor of 2.0 for the centre panel, set the Johansen load of the centre panel at 400 psf. The depth of slab and bottom reinforcement had been determined and the only unknowns for this panel were the clear span and the ratio of hogging to sagging yield moments, i. Ultimate load requirements thus defined a relationship between these two unknowns enabling the choice of both after several trials.

For the corner panels the same reinforcement and i value were used, and since no membrane action enhancement was to be allowed for, the Johansen load of these panels was to be 800 psf.

Only the short edges of the centre-edge panels were assumed to be laterally restrained. The plan dimensions were defined by the centre and corner panel dimensions and since the reinforcement was to be the same as in other panels the Johansen load of these panels could be determined directly. Checking of the lateral stiffness required to enhance this load to 800 psf revealed a reserve of strength. However, values of bottom reinforcement were already minimum and the value of i already well below 2.0 which was considered ideal (see Chapter 2). No modification was therefore made and the Johansen load of the centre edge panels remained at 594 psf.

6.3.2 Assessment of Membrane Action Enhancement of Panel Loads

The equations for ultimate loads of laterally restrained reinforced concrete panels derived by Park[11, 12, 13] were used in assessing the contribution of compressive membrane action towards the overall load carrying capacity of the slab panels.

The requirement of the panels to sustain specified loads enabled the solution of the equations for the maximum allowable lateral spread. This maximum value was used in calculating the magnitude of the membrane forces at ultimate load. These forces were then considered as outward, in-plane loads on the surrounding panels and beams and outward movement under these loads was estimated, allowance being made for elastic, creep and shrinkage strains. Modifications to slab parameters were made until the outward movement under the forces was less than the maximum allowed by an arbitrary safety margin.

An outline of Park's theory and details of the calculation of the maximum allowable lateral spread in the centre and centre-edge panels are given in Appendix A.

The loads acting on a part of the surround and the resulting deformed shape are shown in Figure 6.3(a).

Five principal effects were considered in obtaining the lateral stiffness in terms of a value equivalent to the ϵ'_y value used by Park[11]:

(a) Stretch of the supporting beams carrying the tensions T_1 or T_2 (Figure 6.3(a)).

(b) Bending and shear deformations of the panels A and B under the loading system of Figure 6.3(a).

(c) The axial shortening of a typical slab strip under the compressive membrane forces.

(d) Shrinkage of the slab panel away from the supporting beams.

(e) Creep deformations.

When panels B and C are all loaded and exhibit compressive membrane action, there can be no ring tension in the B panels to counter the forces C in the centre panel. However, before the centre-edge panels exhibit compressive membrane action it is possible for them to carry some of the tension induced in the surround by the membrane action in the centre panel. Compare the two force distributions of Figures 6.3(b) and 6.3(c).

In both cases the mean centre panel membrane force is C and this, in addition to inducing tension into the surround, sets up small bending stresses.

When no compressive membrane forces are present in the centre-edge panel (e.g. before it cracks) it is possible for this section to be in tension and for equilibrium of in-plane forces perpendicular to the section XX, the sum of T_3, T_4 and T_{CEP} must equal C. Hence T_{CEP}

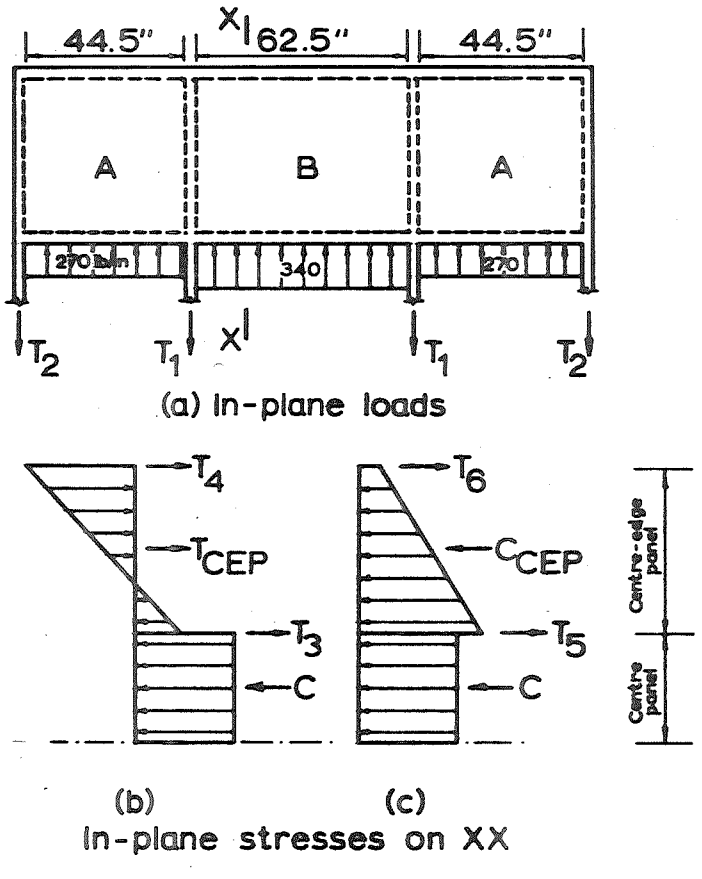


FIGURE 6.3 ACTIONS ON SURROUND

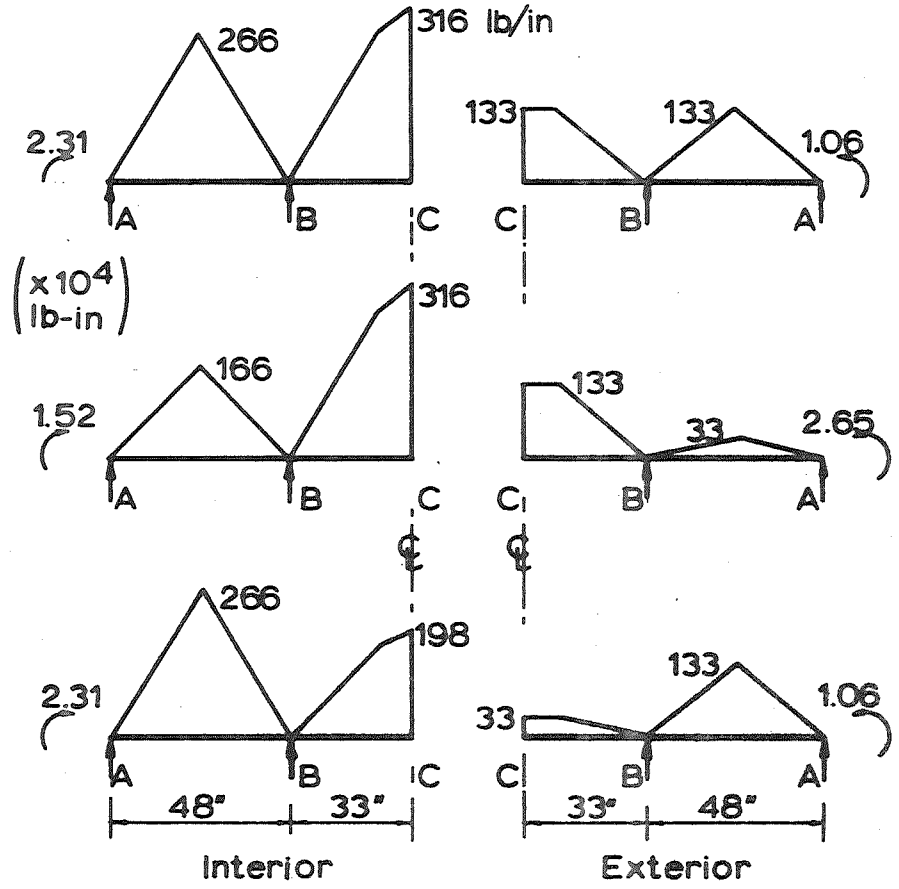


FIGURE 6.4 BEAM LOADING

assists in resisting the tension induced in the surround.

When the centre-edge panels exhibit compressive membrane action, the part of the section XX in the centre-edge panel will be in net compression and will no longer assist in resisting induced surround tension as is seen by the equilibrium equation for in-plane forces:

$$T_5 + T_6 = C + C_{CEP}. \qquad \ldots.(6.1)$$

The beams must therefore take all the tension induced and act as ties. The B panels may, however, contribute to the bending stiffness of the span GH with respect to loads in the plane of the panel.

The span to depth ratio of this panel acting as a deep beam called for the consideration of both bending and shear deformations. These were calculated on the basis of an uncracked, elastic section and then increased in recognition of the loss of stiffness due to cracking and panel deflection under transverse load.

The shortening of the slab strips and extension of the beams were calculated on the assumption that these elements were uncracked, of elastic material and acted upon by axial force only.

Because the slab had lighter reinforcement and a greater specific area than the beams, there was clearly a possibility of the slab shrinking away from the supporting beams and the contribution of this phenomenon in

reducing the effective lateral stiffness was assessed.

Allowance was made for time-dependent deformations which were assumed equal to the short term values.

Design calculations, which are summarised in Appendix A, resulted in:

Clear span dimensions:	62.5" x 62.5"	Centre panel
	62.5" x 44.5"	Centre-edge panels
	44.5" x 44.5"	Corner panels
Panel depth:	1.94"	All panels
Span to depth ratios:	32.2	Centre panel
	22.9	Centre-edge and corner panels
Percentage bottom reinforcement:	.152 %	All panels
Percentage top reinforcement:	.162 %	All panels
Average sagging yield moment:	241 lb.in/in	All panels
Average hogging yield moment:	258 lb.in/in	All panels
Johansen load with 8% reduction:	800 lb./ft^2	Corner panel
for corner effects	594 lb./ft^2	Centre-edge panel
	400 lb./ft^2	Centre panel
Enhancement factors required:	1.0	Corner panel
	1.35	Centre-edge panel
	2.0	Centre panel
Mean membrane force at ultimate:	340 lb/in	Centre panel
	270 lb/in	Centre-edge panel long direction

6.4 DESIGN OF BEAMS

6.4.1 General

(a) Loading Patterns Considered

The load patterns considered in design are shown in Figure 6.2(b). The worst case of full live load on loaded panels and dead load only on the unloaded panels was taken in all cases.

(b) Load Distribution and Computation of Moments and Shears

The triangular load distributions of Figure 6.4 were used in the calculation of both moments and shears. Span lengths were taken as the centre to centre distances and full support moments designed for, moments at the support face being considered to justify the reduction of steel area in cases where provision of the area of steel for the full support moment could not be achieved with a practical bar arrangement.

(c) Basis of Moment Diagram Determination

In order to limit the extension of the centre spans of beams, the degree of moment redistribution was kept to a minimum.

The fixed-end moments at an interior support were computed on the basis of a uniform section and redistributed according to the approximated relative stiffnesses, but in this case the ratio of the stiffness did

not greatly affect the final moments because of the small difference between the two fixed-end moments.

(d) Effect of Tension on Flexural Steel Requirements

The axial tensions induced in the centre spans of the beams called for a modified design method.

Equations 4.14 and 4.15 were used to determine the reinforcement content.

The provision of considerable extra steel to accommodate the tension posed problems at the supports, since according to the assumptions made, it was required on one side of the support and not on the other. Curtailment could not always be achieved and the section carrying no tension remained overdesigned.

(e) Curtailment of Flexural Steel

Required steel areas were calculated for four critical sections in each beam, viz., at the middle and ends of the centre span and the end and point of maximum positive moment in the outer spans. Curtailment followed the bending moment diagrams with due recognition of the tension to be carried. The small range of bar sizes available led to uneconomical arrangements in some cases.

(f) Torsion

Considerable torsional moments in the exterior beams resulted from the required development of full hogging

yield moments along the slab edges supported by these beams. The mid-point of each span was taken as a point of zero torque and no effort was made to redistribute the torsional moment imbalance at the beam junctions according to the flexural stiffnesses of the adjoining beams at right angles. Considerable positive bending moments were induced in the ends of these latter beams as a result of the edge beam torsion.

(g) Shear

Inclined stirrups were included in recognition of the steepening of shear cracks when axial tension is present. In spans subject to axial tension, the concrete was assumed to take no shear.

A summary of design results for the beams is given in Table 7.1.

6.5 CONSTRUCTION

6.5.1 General

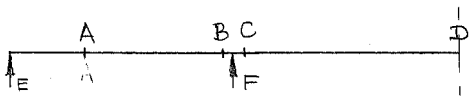
The floor was constructed in place on the strong floor of the Post Graduate Laboratory. Construction of formwork began in June 1967 and the concrete was placed in November 1967.

6.5.2 Formwork

The channels forming the beam soffit were placed on the supporting columns and levelled before the individual

Table 6.1. Summary of design results for beams.

Quantity	Units	Interior Beam At A	At B	At C	At D	At E	At F
Tension	Kip	0	0	17.6	17.6	-	-
Moment	lb" x 10^4	+3.03	-7.00	-7.00	+5.50	-	-
Shear	lb" x 10^4	n.c.	.50	.58	0	-	-
Torque	lb" x 10^4	n.c.	n.c.	n.c.	n.c.		
Flexural steel	in^2	.11	.24	.57	.32		
Long. torsion steel	in^2	0	0	0	0		
Steel placed	in^2	.11	.22	.54	.32		
Reactions (800 psf) in pattern 1)	Kip	-	-	-	-	1.39	10.7



Quantity	Units	Exterior Beam At A	At B	At C	At D	At E	At F
Tension	Kip	0	0	5.2	5.2	-	-
Moment	lb" x 10^4	+1.55	-3.29	-3.29	+2.66	-	-
Shear	lb" x 10^4	n.c.	.25	.28	0	-	-
Torque	lb" x 10^4	n.c.	.96	1.25	0		
Flexural steel	in^2	.07	.15	.25	.16		
Long. torsion steel	in^2	0	.086	.102	0		
Steel placed	in^2	.10	.32	.32	.15		
Reactions (800 psf) in pattern 1)	Kip	-	-	-	-	.75	5.4

n.c. - denotes not critical.

panel forms were placed and secured (Figure 6.5). Corrugated cardboard was used on the sides of the beam cavities to facilitate stripping. Adhesive tape was used to seal all cracks and a level check performed when all panels were positioned.

6.5.3 Steel Placement

Reinforcing cages for the exterior beams were made separately while the four interior beam cages were made up as a single unit. All beam steel was positioned before the slab steel was placed.

Mortar blocks tied to the reinforcing at strategic points were used to ensure correct cover to the steel at the sides and bottom. Ties through the beam soffit served to prevent the steel riding up and gave further rigidity. All beam steel was tied and no welds were used.

The bottom and top slab steel layers were then placed, tie wires again being used for all joints. All bottom steel was continuous for the whole width of the floor with some bars, top and bottom, being passed through the side beam moulds where they were anchored and tightened slightly to assist lining up and general rigidity. In the top reinforcement, in cases where tie wires proved insufficiently firm, a spot of Araldite glue was used to give a firm join. Mortar pads were again used to ensure correct cover.

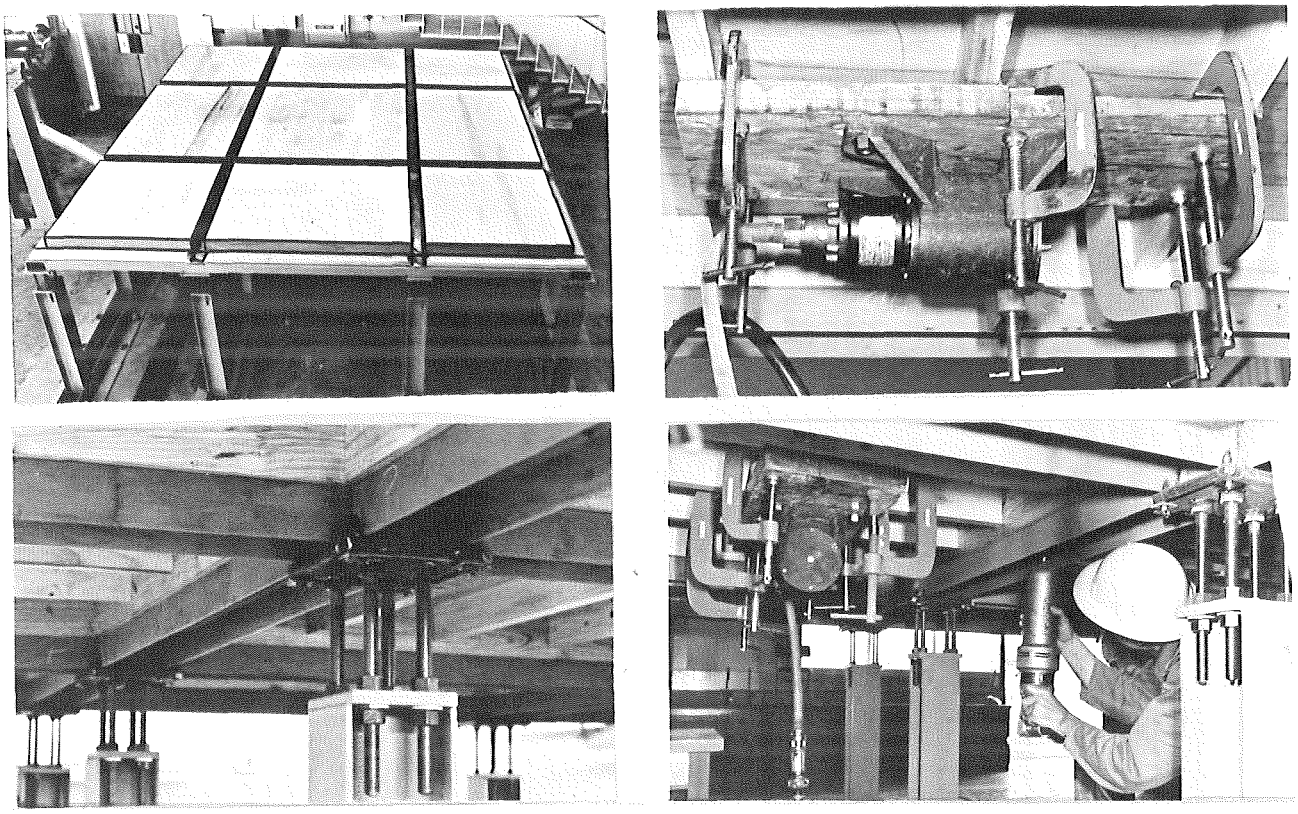


FIGURE 6.5 FORMWORK AND VIBRATION EQUIPMENT

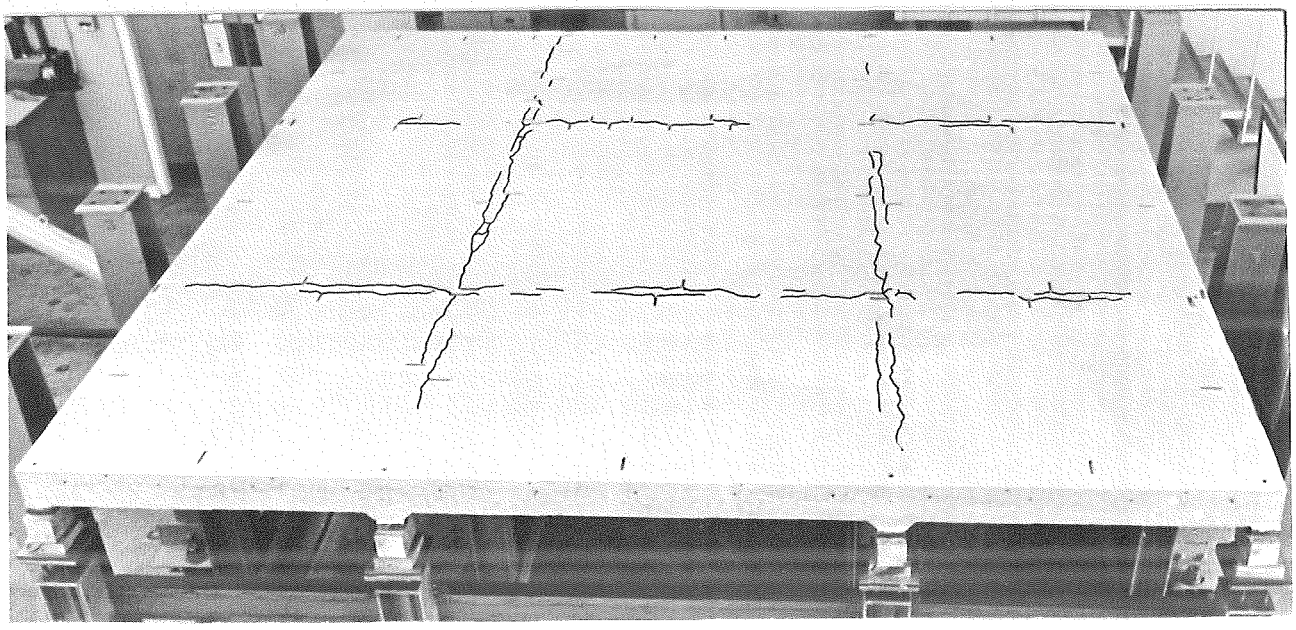


FIGURE 6.8 TOP SURFACE SHOWING SHRINKAGE CRACKS

Figure 6.6 shows the reinforcement as placed.

A thorough check of levels and cover was made after all steel was placed and secured.

6.5.4 Concrete Placement

Concrete was first placed in all the beams up to the level of the panel forms and vibrated with kango hammers. Placement of the panel concrete then proceeded panel by panel, pneumatic form vibrators being used for compaction (see Figure 6.5).

The surface was screeded in two halves with a timber board using a 2" pipe as an intermediate support. After trowelling and initial set, the floor was covered with damp hessian and polythene.

6.5.5 Curing and Stripping

The formwork could not be removed until sufficient concrete strength had been developed to ensure that cracking would not occur. The possibility of adverse effects due to drying shrinkage of the slab relative to the formwork meant that the concrete had to be kept moist until stripping of the formwork, 26 days after casting.

Stripping of the formwork was achieved by suspending the floor from 16 hangers supported by a frame erected over the slab. This enabled the panel forms and channels to be removed from underneath with little possibility of cracking. When stripping was complete, the slab was again

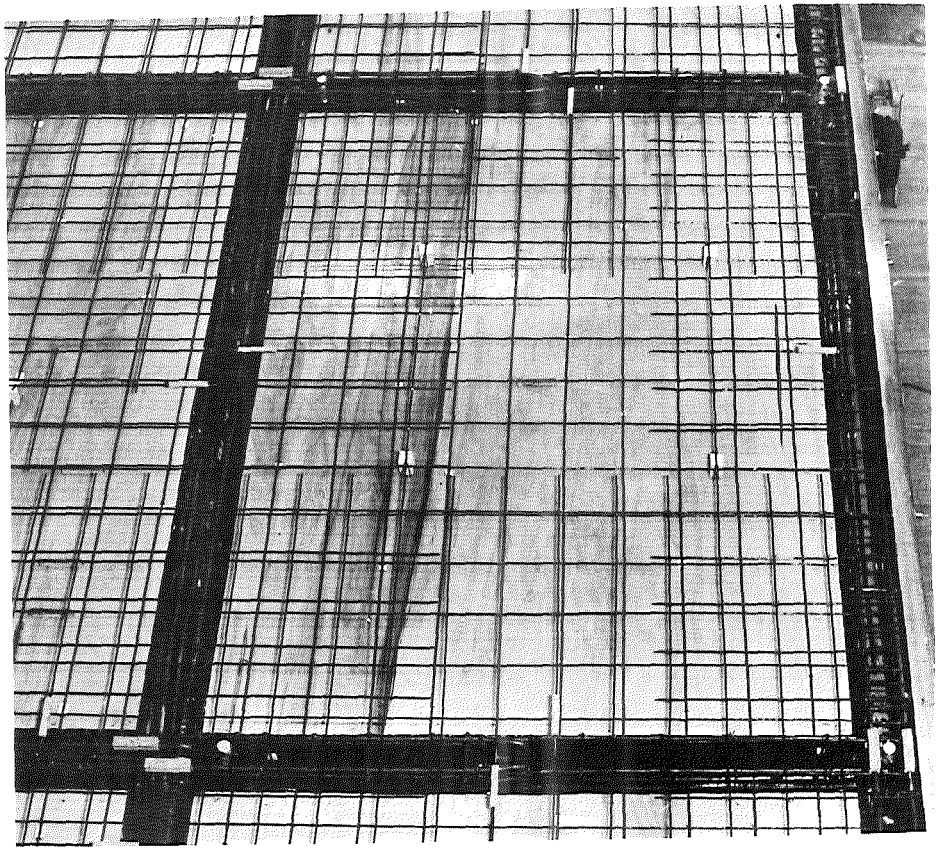


FIGURE 6.6

REINFORCEMENT IN MODEL FLOOR

supported from underneath and the frame over it removed.

A check on the thickness and level was then made using a precise level with a foot rule as staff. The results of this check are given in Appendix B.

6.6 MATERIAL PROPERTIES AND FINAL SLAB DIMENSIONS

6.6.1 Material Properties

6.6.1.1 Concrete

The concrete used was one batch of a specially mixed mortar supplied by a ready-mix concrete contractor. This had a maximum aggregate size of $\frac{1}{4}$" and a water-cement ratio of .69. Details of the mix are given in Appendix B.

The average strengths measured by tests on control specimens before and after the test were as follows:

Cylinder strength, f'_c = 4350 psi

Cube strength, u = 5080 psi

Modulus of Rupture, f_t = 690 psi

Figure 6.7 shows the stress-strain curves of tests on two 12" x 6" diameter cylinders and two 18" x 6" x 6" prisms used to determine the modulus of elasticity, values of which are shown on the figure.

In addition to the normal control specimens, two 18" x $7\frac{1}{2}$" x $3\frac{1}{2}$" blocks, two 18" x 6" x $3\frac{1}{2}$" blocks and one strip 36" x 8" x 1.94" were cast without reinforcement. Demec gauges were used to take three readings of shrinkage strain on each block. The graphs of unrestrained shrink-

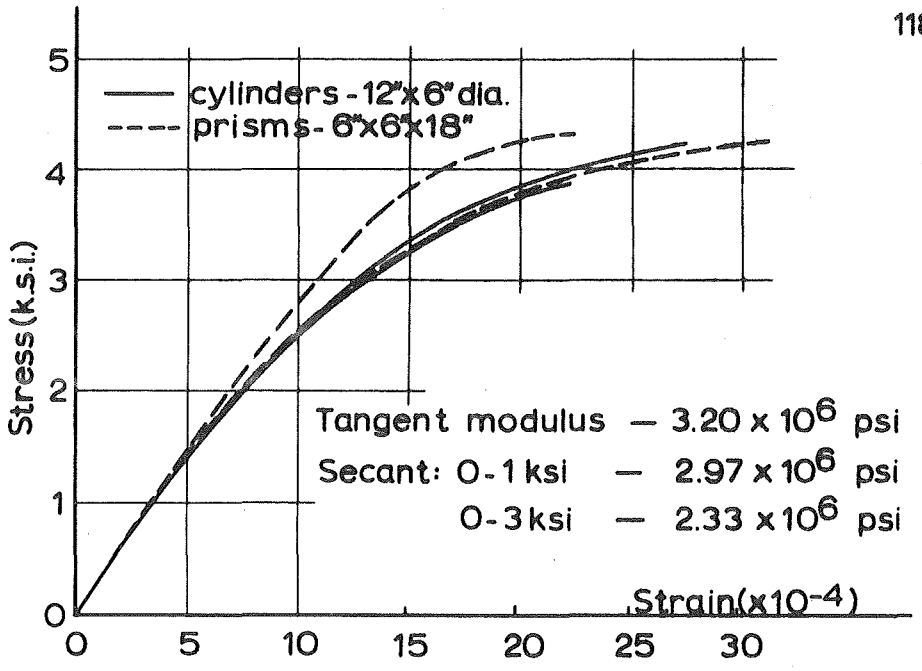


FIGURE 6.7
STRESS — STRAIN CURVES FOR CONCRETE

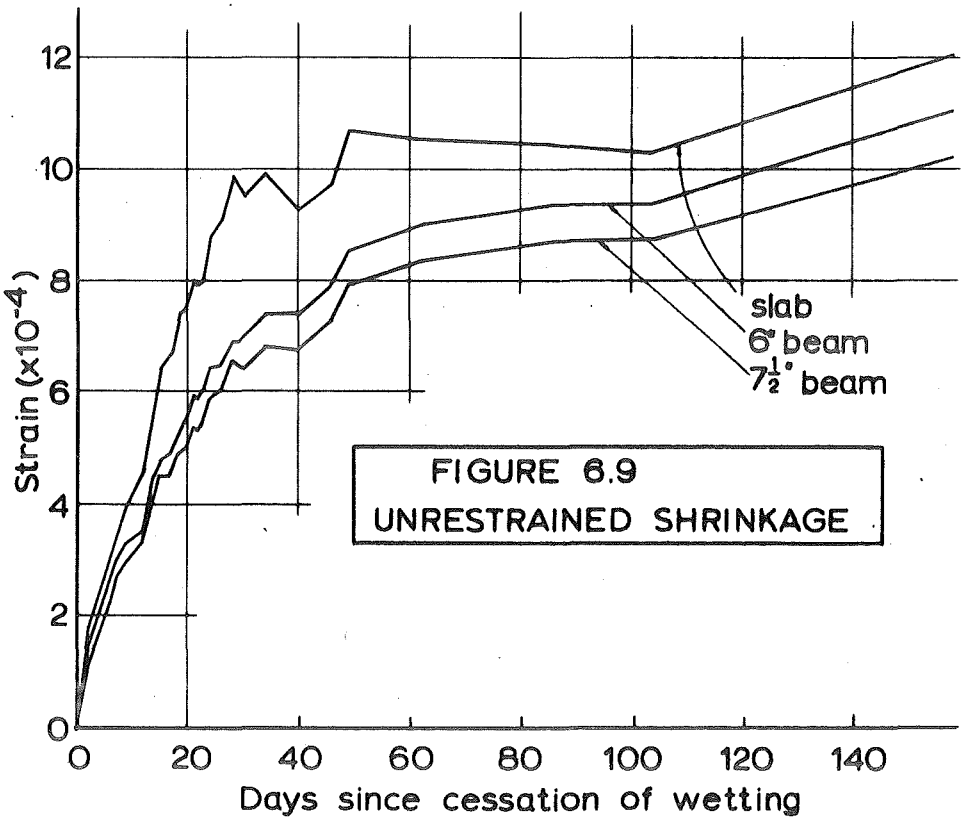


FIGURE 6.9
UNRESTRAINED SHRINKAGE

age strain, corrected for temperature, against time indicate appreciable differential shrinkage between slab and beam elements. Twenty-eight days after the cessation of wetting, cracks appeared around the edges of most panels on the top surface only (Figure 6.8). Figure 6.9 shows that the maximum differential shrinkage occurred at this time and it seems certain that the cracks of Figure 6.8, ranging up to .002 in width, were caused by this differential movement.

6.6.1.2 Steel

Three different sizes of bar and two different types of steel were used in reinforcing the floor. Supplies of the $\frac{1}{8}$" diameter, lead bath annealed, British steel were limited and the New Zealand soft drawn wire was used for stirrups.

Figures 6.10 and 6.11 show typical stress-strain curves for the steel used. The lead bath annealed steel showed a distinctly bi-linear characteristic and since the yield plateau was extended and flat, the stress at the level of the yield plateau was taken as the yield stress. For the soft drawn wire, the yield stress was taken to be that at .2 per cent proof stress.

Results of the test on steel samples are given in Appendix B.

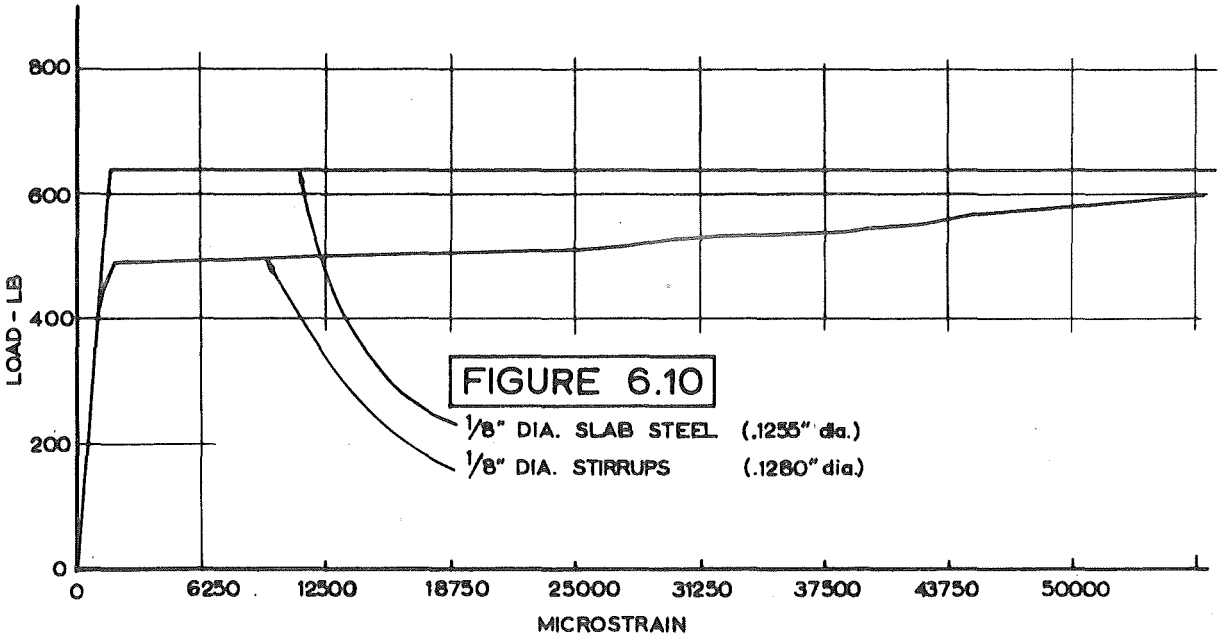


FIGURE 6.10

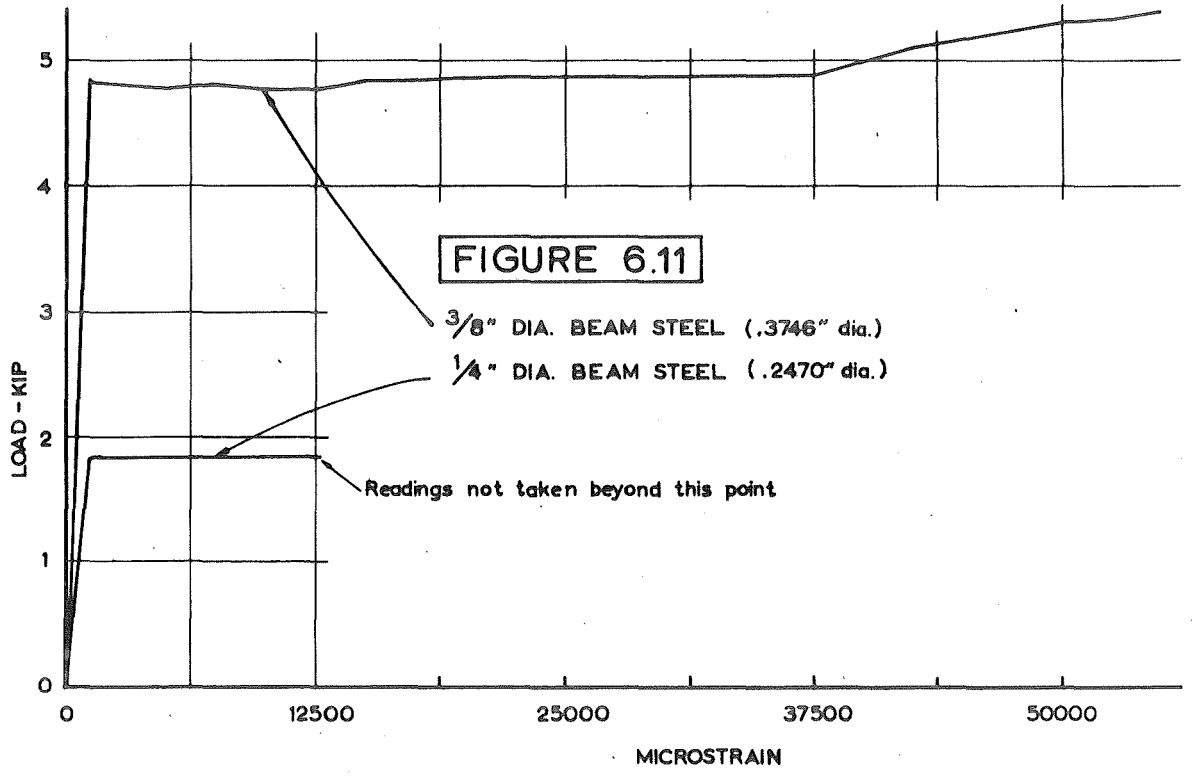


FIGURE 6.11

6.6.2 Final Slab Dimensions

(i) Level of Top Surfaces: Precise level readings on the top surface taken to ±.005" varied from -.20 to +.15" above the mean level. The standard deviation of the 169 readings was .073". The planeness of the top surface was better than these figures indicate since readings revealed a small overall slope.

(ii) Panel Thickness: The overall average of nine readings per panel was 1.976" with range of ±.11" and a standard deviation of .048". At the end of the test, thickness measurements were taken at the edges of the centre panel (E), and a centre-edge panel (H) and a corner panel (J). The average of all these readings was 1.904".

(iii) Beam Thickness: Beam depths were measured at the ends and quarter points of each span before the test. Results were:

6" beams: Average depth = 5.965", s.d. = .036"

7½" beams: Average depth = 7.490", s.d. = .030"

(iv) Cover to Steel: A check was made after the test. Both panel and beam steel cover were generally within 1/32" of the expected value.

Fuller details of the measurements of the slab are given in Appendix B.

CHAPTER 7

INSTRUMENTATION AND TEST PROGRAMME

7.1 INSTRUMENTATION

7.1.1 Reaction Measurements

Figure 7.1 shows details of a support B2. The 10-ton capacity Philips PR 9226 electrical resistance load cell is shown sitting between a two-way roller system and a $1\frac{3}{4}$" mild steel bearing pad. Adjustment of the nuts at the column head enabled the whole assembly to be levelled. All reaction points were of similar form. The roller supports for the outer ring of support points were $\frac{1}{4}$" ball bearings between hardened, ground plates. Two of the inner supports (B3 and C2) had one-way-rollers while support C3 was fixed against horizontal movement ensuring that, although the floor as a whole could not move, all reactions were vertical.

Each load cell was wired to a 16-way, four-channel switch connected to a Budd Strain Indicator, and readings on each cell recorded manually. Values of reactions were calculated using the load-strain calibration curves obtained for each cell as a result of tests performed before and after the testing of the floor.

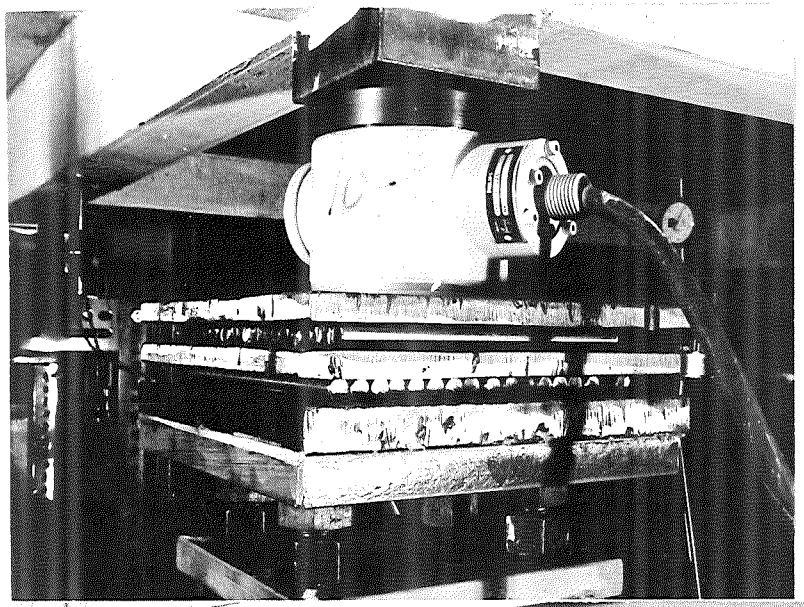
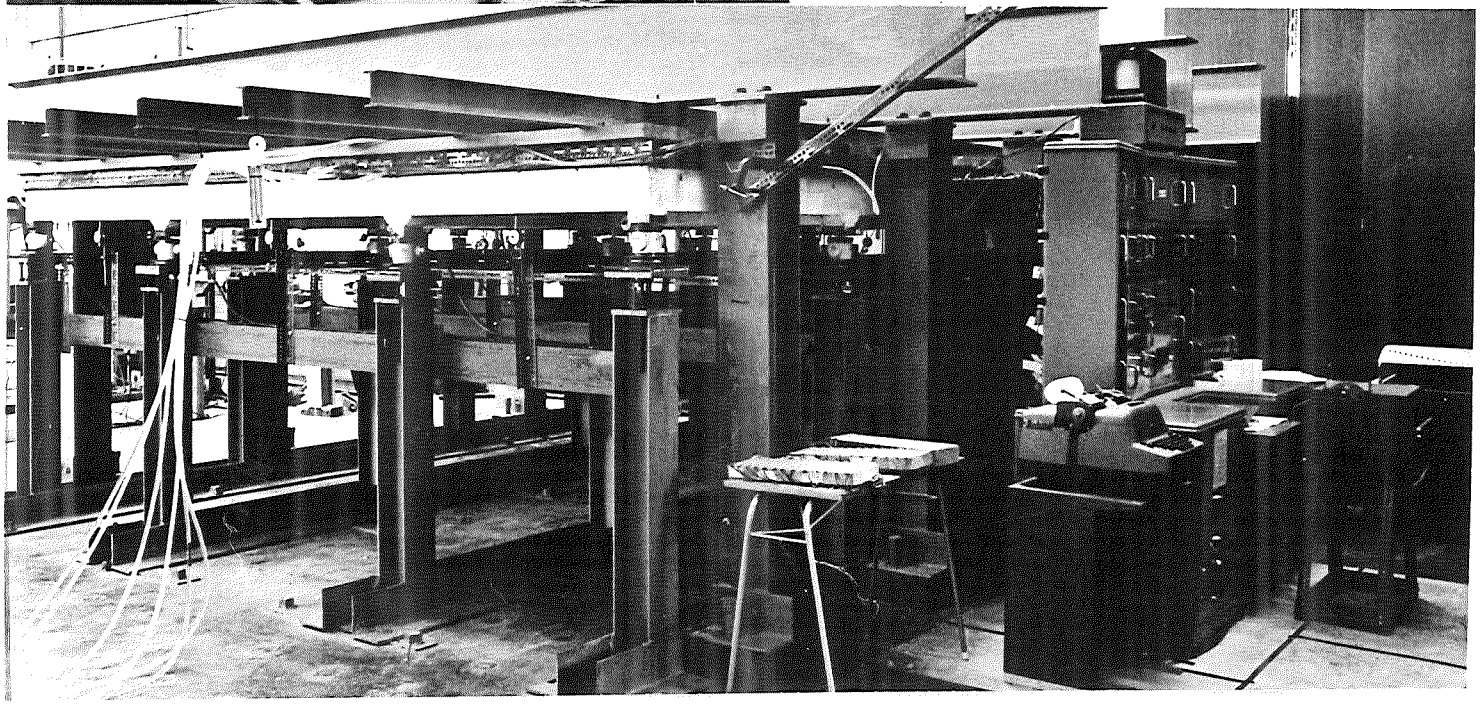


FIGURE 7.1 DETAIL OF SUPPORT B2

FIGURE 7.4 TEST SET-UP



7.1.2 Strain Measurement

Strain gauge positions are shown in Figures 7.2 and 7.3. All gauges were wired to a 140-channel strain data logger in a two-arm circuit. The data logger (right foreground of Figure 7.4) was accurate to $\pm 5\mu S$ and could read automatically each gauge in turn. A digital voltmeter incorporated in the logger provided output, in microstrain units, on a typewriter and tape punch.

The automatic switching facility required that each active gauge have its own dummy.

The active concrete gauges were Philips PR 9810 C/11 (600 ohms, flat grid, 1 inch gauge length, $\frac{3}{4}$" grid width) glued directly to the concrete with Philips cement kit PR 9244/04. Concrete dummy gauges were of the same type and glued in the same manner to the three concrete blocks to be seen in Figure 7.4.

Active steel gauges were BLH SR-4 A-12 paper backed gauges (flat grid, 1 inch gauge lengths, 120 ohms, gauge width, 3/32"). The reinforcing steel was exposed by the removal of the cork blocks and considerable care was necessary in obtaining uniform adhesion onto the $\frac{1}{8}$" diameter bars. Grooved rubber pads were used to form the gauge around the bars. Nitrocellulose adhesive from the Duco Cement kit was used throughout. Dummies for these gauges were temperature-compensated, 120 ohm gauges mounted on Aluminium. Two unstressed SR-4 gauges mounted

in the same way as the active gauges and having dummies on the aluminium, were used to assess the effects of temperature on the strain readings.

Following initial placement, all gauges were checked for continuity and resistance to earth, the necessary replacements being made until all gauges were satisfactorily mounted. Gauges were then waterproofed with wax.

The 140 channels of the data logger were split into blocks of 20, the first channel of each block being wired to a Philips PR 9249A dummy strain gauge to check drift.

Gauges 7-32 were placed so as to afford measurement of membrane force in the centre panel in a region of low moment. Gauges 33-46 provided this facility in a centre-edge panel, 47-50 in a corner panel.

Gauges 78, 79, 76, 80, 82 were placed to give an indication of T-beam flange widths. Hair cracks normal to the line of the gauges in mid-span necessitated their placement slightly off centre.

Gauges 112-120 were placed for measurement of moment and membrane action force in a region of high moment. Gauges 94, 95, 105-108 served a similar purpose for a centre-edge panel.

All other gauges were placed to give an indication of stress levels at critical points and in some cases, means of calculating moments and forces at a section.

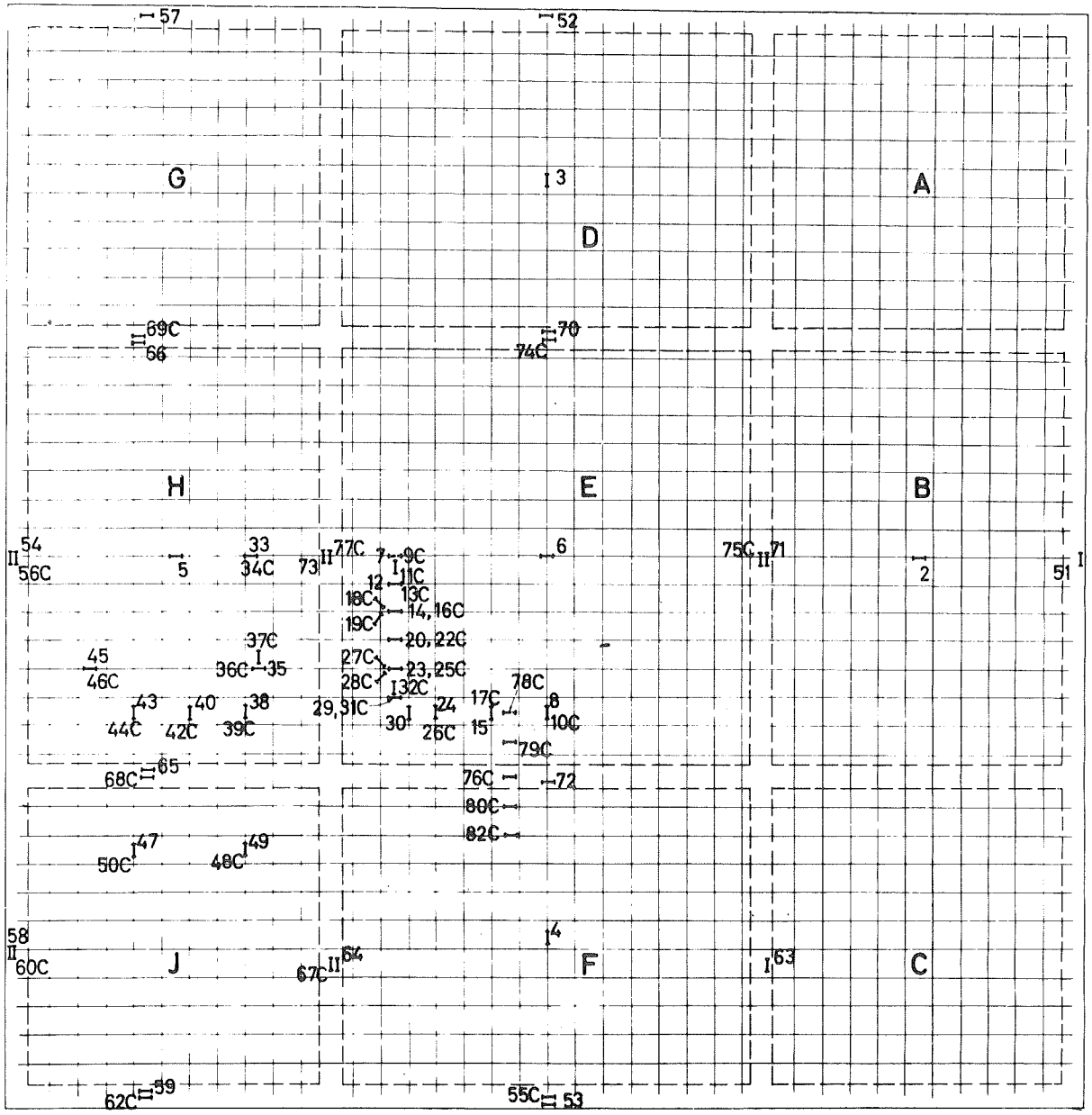


FIGURE 7.2

STRAIN GAUGE POSITIONS ON BOTTOM STEEL

I - Denotes strain gauge position

C - Denotes concrete gauge on upper surface

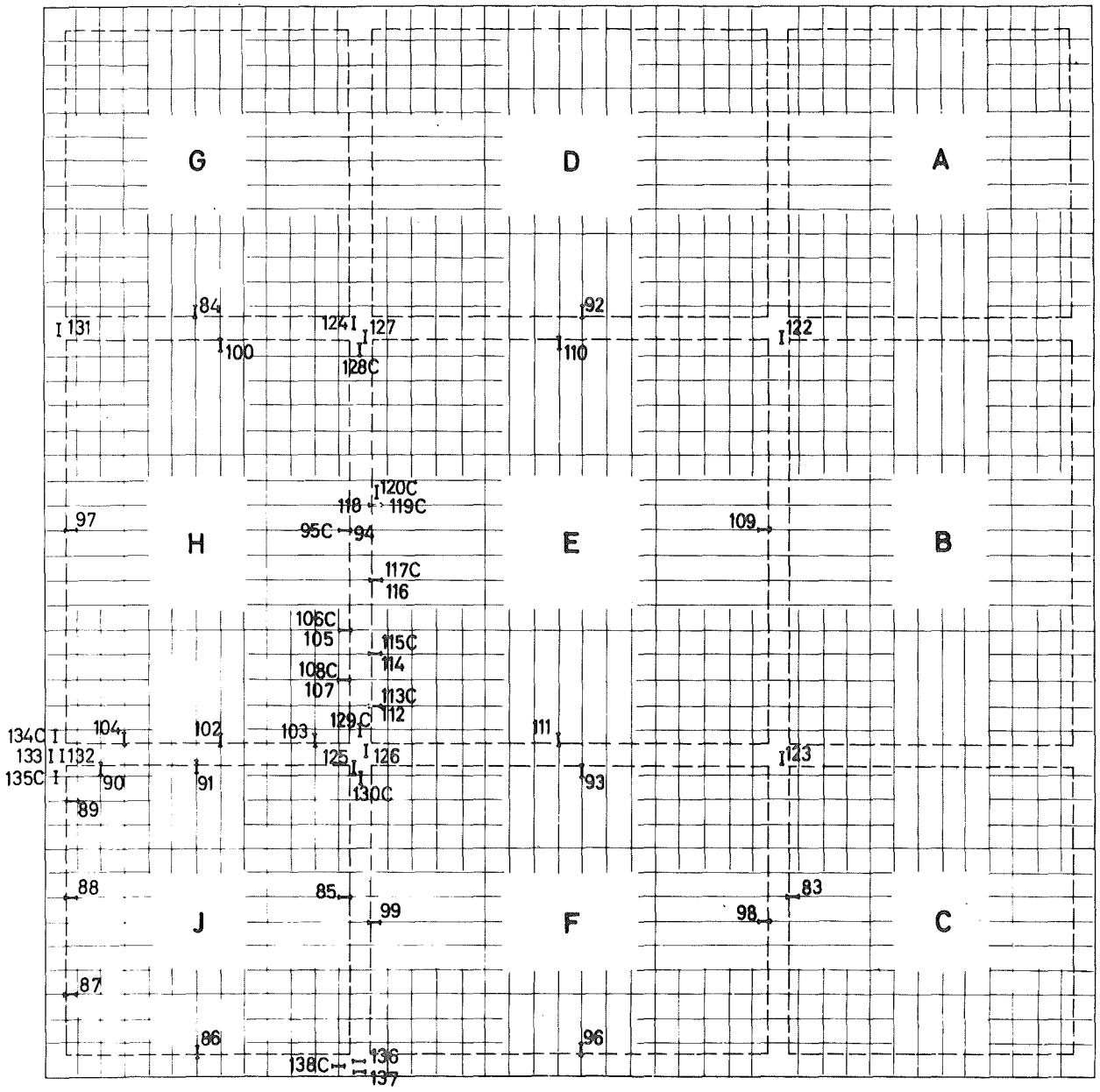


FIGURE 7.3

STRAIN GAUGE POSITIONS ON TOP STEEL

I - Denotes gauge position

C - Denotes concrete gauge on underside

7.1.3 Deflection Measurement

Dial indicators mounted on a 'Dexion' frame attached near the top of the supporting columns were used to measure deflection at critical points.

One at the centre of each panel and one at the centre of each beam span provided vertical deflection data.

Gauges to measure horizontal movement at supports B3, B2, C2 were placed to measure movement in the direction of the rollers at the support points (North-South at B3, East-West at C2 and both North-South and East-West at B2).

7.1.4 Load Application and Measurement

Water-filled bags placed between a reaction platform (erected over the slab and tied down to the laboratory floor) and the top surface of the slab provided means of load application.

Nine bags (one over each panel) were made with a 3" high wall and covered the whole top surface of the slab when placed and filled with water.

Pressure was applied by forcing water into the bags. The four corner bags were inter-connected, there being no provision to have one corner panel at a higher load than the other three. The same was true of the centre-edge panel bags. The centre panel bag was a separate system.

Figure 7.5 is a diagrammatic representation of the

hydraulic loading system. Apart from the main feed hose which was 1" diameter, all hoses were $\frac{1}{4}$" diameter plastic tubing.

The main feed hose came from a constant head device which could be adjusted to any level to suit the load requirements, providing an effective means of maintaining the load at the set level.

Due to scaling down in the model, there was a difference of 75 psf between the self weights of prototype and model. Another constant head device fixed at the appropriate height above the level of the slab was used to apply this difference so that the self weight of the model plus the applied "dead load" was equal to the prototype dead load. This load was the starting point for all tests.

For pattern loads where two different load levels were required, panels not loaded with live load were switched to the "dead-load-only" constant head device leaving the variable device for setting of the live load on the others.

When the lower load of a pattern was greater than the prototype dead load, a mercury manometer was used to set the load and the dead load device was not used.

The mercury manometer served also as a means of checking the reading on the calibrated variable head device.

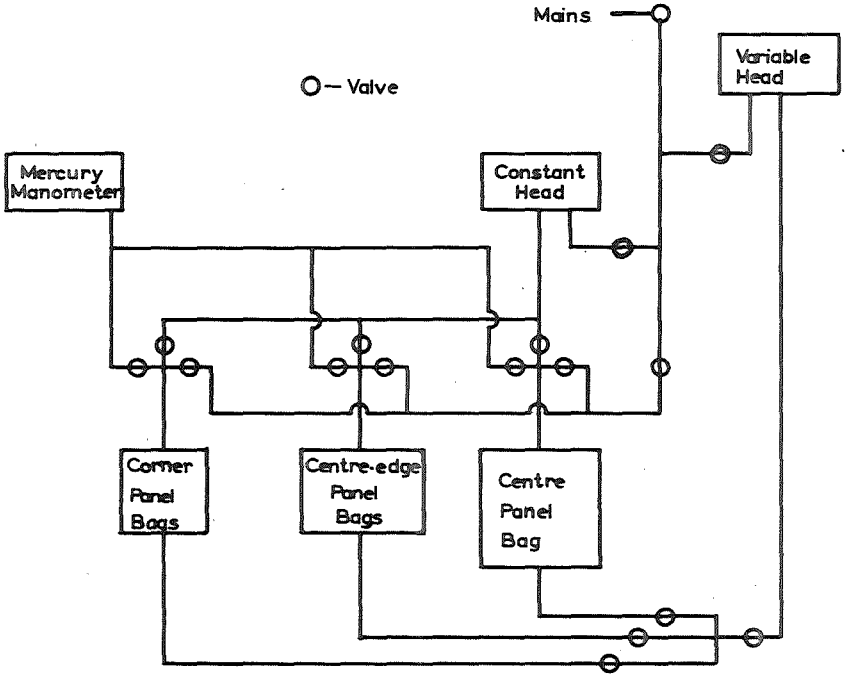


FIGURE 7.5 LOADING SYSTEM

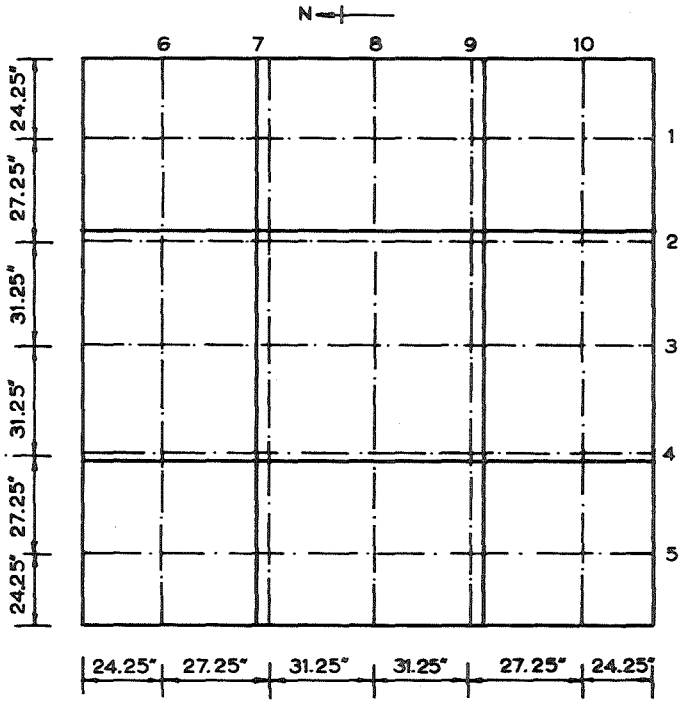


FIGURE 7.6 MOMENT LINES ACROSS SLAB

7.2 TEST PROGRAMME

7.2.1 Dead Load Reactions

The 75 psf difference between the prototype and model self weights was applied to the model throughout the programme. The application of this load provided a more stable arrangement in reducing the difficulty of setting and maintaining the dead load reactions at the required level. These reactions were set several times before the testing programme was started, for as long as the tendency for the corners to lift remained. When tolerable stability had been achieved, Tests 101 and 102 were performed.

In the design, moment redistribution was kept to a minimum and for this reason the dead load reaction for each support was taken equal to the reaction at ultimate load, scaled down linearly.

An initial setting of reactions was made for self weight only, before a more accurate setting was performed for prototype dead load. Successive trials were made until the required value at each point was obtained.

The corner reactions tended to reduce due to uplift and reactions were reset after Test 102 because this tendency was then less and small differential movement of reaction points had caused some redistribution. After this no further reaction adjustment was made.

7.2.2 Load Tests Performed

The overall test programme, carried out between 6th and 22nd May 1968 is summarised in Table 7.1.

Table 7.1. Summary of tests performed.

Test No.	Load Stage Nos.	Maximum Panel Loads (psf) Centre	Centre -Edge	Corner	No. of Increments Up	Down	Remarks
101	1-10	225	225	225	7	3	
102	13-23	225	225	225	7	5	
103	25-38	225	75	225	7	6	
104	51-63	75	225	75	7	6	
105	1A-13A	225	225	225	7	6	
106	76-94	375	375	375	12	10	
107	95-109	375	375	375	7	13	(Live load (removed from (outer panels (with centre (panel load at (375
108	114-132	400	75	400	10	9	
109	133-151	200	375	200	10	12	(Corner and (centre panel (loads adj- (usted to give (upward corner (reactions
110	152-167	450	450	450	11	10	
111	168-189	375	375	375	9	12	(Outer panels (held at 225 (while C.P. (loaded to 375 (and back. All (then loaded to (375
112	189-220	775	775	775	16		(66 hours at 375 (then loaded to (775
113	221-227	850	850	6			(To failure of C.P.
114	228-239	600	966	1170	8		(To failure of (centre-edge (then corner (panels

Figures in psf are applied loads including the 75 psf difference between model and prototype self weights. Three hundred and seventy-five psf is dead load plus full live load. Seven hundred and seventy-five psf is twice dead load plus twice full live load.

Full details of all load increments are given in Appendix C.

7.2.3 Procedure at Each Load Increment

The load was set using the hydraulic system described in 7.1.4, a period of a few minutes being allowed for the system to settle. A check between mercury manometer readings and variable head device setting was used to ensure that a static state had been achieved.

Dial indicator readings were then taken, the load cell readings taken once and one cycle (140 channels) of strain readings performed. The whole floor was then checked for cracks, new cracks being marked with the corresponding load stage number. Load cell readings were taken again and if considerable cracking or reaction distribution had taken place since the start of the increment a further cycle of strain readings was taken.

On the completion of reading the load was set for the next increment and during the time taken for the load of the next increment to settle graphs of load versus deflection and load versus strain were drawn for some critical points.

7.3 REDUCTION AND PROCESSING OF RAW DATA

7.3.1 Deflections

Readings were taken in ten thousandths of an inch and punched into cards. The start of Test 104 was used as datum in the reduction of all readings.

7.3.2 Reactions

Bridge readings taken for each reaction point were punched into cards and the reactions at each point computed on the assumption of a linear relation between load and bridge reading. Calibration of each load cell provided the constant relating the two quantities.

As a check, the sum of the reactions was compared with the total applied load plus self weight, in which the total applied load was the sum of the products of the nominal bag pressure and full panel areas. In all cases the sum of the reactions was the smaller quantity since the bags could not be made to apply pressure over the whole area, due to curvature of the bag walls. The effective loaded area was 94 per cent of the total top surface area. The "clear span" area of slab panels was 81 per cent of the total top surface area so that the load applied represented some loading arrangement in between the total area and the clear span area of the panels. Placement of the bags was such that the unloaded area was directly above the beams and therefore each slab panel was subject to the full measured bag pressure over

its total clear span area. No reduction of this value was therefore necessary to obtain the pressure sustained by the panels.

Figure 7.6 shows the lines along which moments were calculated from the reaction values and applied loads, the latter being scaled down by the ratio of effective loaded area to total top surface area.

The moments so calculated were used in checking the results of moment computations from strain readings and in assessing moment redistribution.

7.3.3 Strain Readings

Readings of each gauge in microstrain were punched onto paper tape and processed by computer. The raw strain readings were reduced in the following manner.

(i) Datum correction

A particular load stage was chosen as datum, and for each gauge and the reading at the datum stage was subtracted from all other readings.

(ii) Drift correction

The first channel of each block of 20 gauges was a standard strain gauge of high stability. The variation of reading in these gauges was used to assess the electrical drift of the Strain Data Logger. Variation was not great (see Appendix D listing of gauges 1, 21, 41, 61, 81, 101, 121). The readings of gauge 81 were taken as representative and the datum-corrected reading

of this channel at any load stage was subtracted from the readings of all other channels at that stage.

(iii) Temperature correction

Dummy gauges for the active concrete gauges were of the same type and mounted on similar concrete blocks. Thus variations of length due to temperature were assumed to be compensatory and the concrete strain gauge readings assumed to require no correction for temperature.

The active steel gauges had dummies which were temperature compensated and mounted on aluminium. Temperature could therefore be expected to affect the readings of the steel gauges. To compensate, two steel gauges, (Nos. 139 and 140), mounted in the same fashion as the active gauges were used. These were of the same type and were mounted on steel reinforcement embedded in a block of concrete. The blocks remained unstressed by external forces and had identical dummies to the active gauges. The datum-corrected reading of channel 140 was subtracted from all steel gauge readings at each load stage to correct for temperature.

(iv) Special drift correction

At the beginning of each test, up to LS 151 (see Table 7.1), the corrected reading of each channel was compared with the corrected reading of that channel at the end of the previous test. If any difference occurred, the readings of the gauge in the test to follow were

corrected by this difference.

(v) Zero correction

Initial balancing of the gauges was performed when the total load on the slab was 100 psf. Allowance for this initial load was made by computing the difference in readings of each channel at LS1 (75 psf applied) and LS5 (175 psf applied) and adjusting all readings of that channel by this amount.

At sections at which measurement of normal force and moment were to be made one gauge was mounted on the main steel and one mounted on the opposite face of the concrete. This permitted the determination of the strain profile, assumed linear, across the section. This linear strain profile as given by the corrected strain readings was used, in conjunction with section properties, to determine the actions on the section. Computer sub-routines were written to compute the steel and concrete forces resulting. The stress-strain curve for the steel was assumed to be tri-linear and the stress-strain relationship for the concrete was assumed to be of the form proposed by Hognestad et al.[20]. The derivation of the subroutines is described more fully in Appendix E.

7.3.4 Computation of Section Actions from Strain Readings

7.3.4.1. General basis

The subroutines, CONACT and STEEL, described in

Appendix E were written to calculate the concrete and steel action in a section whose strain profile was linear. In the computation of section actions from the test readings, a linear profile was defined by a measured concrete strain and a measured steel strain.

The steps in the computation were as follows:

(i) Reduction of strain readings

This was done by the method outlined in Section 7.3.3.

(ii) Computation of strains for equivalent strain profile

(a) Equivalent steel strain: (e_s)

When two steel strain readings were taken at the section at the same level, the average value was taken. In cases where only one reading was taken, this was assumed to be the strain in the section at the level of the centroid of the steel.

(b) Equivalent concrete strain: (e_c)

When only one gauge was used it was placed parallel to the steel bar and the concrete gauge reading was taken as the section strain at the face of the concrete.

When two concrete gauges were used, one was at right angles and the other parallel to the reinforcement. Poisson effect was considered in reducing e_c according to the relation:

$$e_c = (e_1 + e_2)/(1-\mu^2)$$

where e_1 = concrete strain measured parallel to reinforcement

e_2 = concrete strain measured perpendicular to the reinforcement

μ = Poisson's ratio

For the two sections for which three concrete gauges were used these were in 120° "rosette" form and two-dimensional strain analysis was used to obtain the principal strains which were used to obtain the equivalent strain component parallel to the reinforcement.

The strain profile was then defined, and was as shown in Figure 7.7.

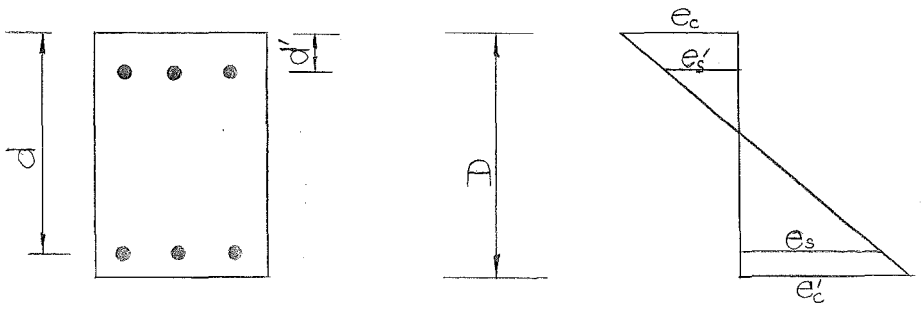


FIGURE 7.7. STRAIN PROFILE.

Values of equivalent top and bottom concrete strain, e_c and e'_c were computed directly and stored. Values of e_s and e'_s were likewise stored. For each load stage, the strains e_c, e'_s, e_s and e'_c corresponding to the strain profile defined by the values computed for e_c and e_s were

calculated and stored.

(iii) Computation of concrete actions

The values of e_c and e'_c were used in the subroutine CONACT as top and bottom concrete strains and the concrete forces determined.

(iv) Computation of steel actions

Arrays of top and bottom steel strains had been stored. The loading and unloading performed during the test necessitated the examination of the strain history to determine the plastic portion of the indicated strain. The method used to determine this is shown in Figure 7.8.

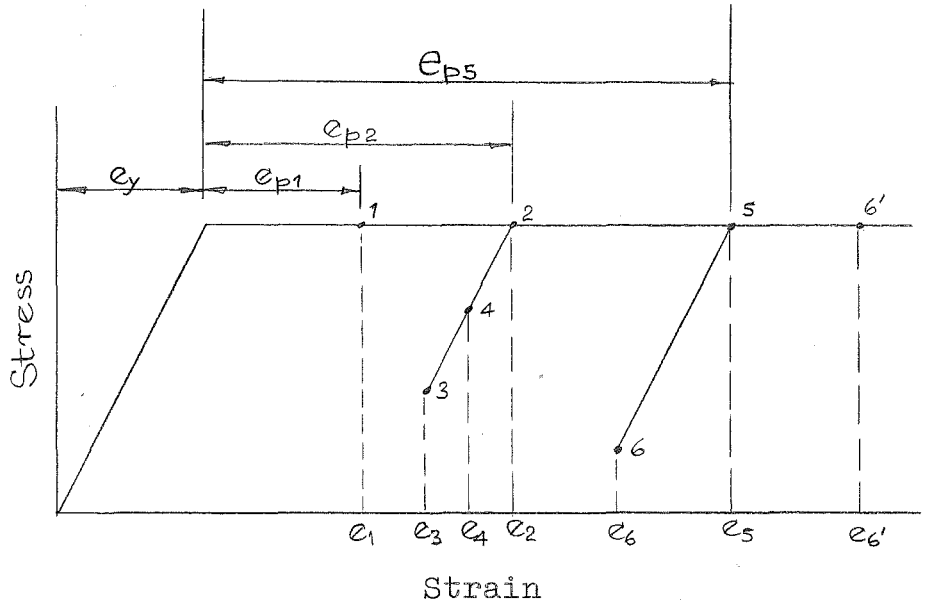


FIGURE 7.8. STEEL STRAIN DETERMINATION.

Consider the strain, e_1 as known to be on the yield plateau. The elastic portion of e_1 is $e_1 - e_{p1} = e_y$. If the next four strains are e_2, e_3, e_4 and e_5 as shown, then,

because e_1 is on the yield plateau and e_2 is greater than e_1, e_2 is also on the yield plateau and the plastic strain is then e_{p2}. e_3 is less than e_2 and unstressing is elastic and the plastic strain portion of e_3 is still e_{p2}. e_4 is greater than e_3 but it is found that $e_4 - e_{p2}$ is less than e_y so that the plastic strain portion of e_4 is also e_{p2}. $e_5 - e_{p2}$ is found to be greater than e_y and a new plastic portion e_{p5} must be defined to apply to consequent strains. Whether or not this applies to e_6, clearly depends on whether $e_6 - e_{p5} > e_y$.

Each array of top and bottom steel strains was searched in the manner outlined and only the elastic portion of the strain retained for input into subroutine STEEL for computation of steel forces.

(v) Calculation of section moments and forces

Output from the subroutines CONACT and STEEL were in non-dimensional form, giving the steel and concrete forces and moments, acting at and about the mid-depth. These non-dimensional values, $M/f'_c bD^2$ and $T/f'_c bD$, were multiplied by the appropriate values of $f'_c bD^2$ and $f'_c bD$ respectively.

(vi) Cracked and uncracked sections

In tension the concrete stress-strain curve was assumed to be linearly elastic with a modulus of elasticity as given by the secant from 0 to 1000 psi on the compressive stress-strain curve.

For each load stage the concrete was assumed first to be uncracked in which case concrete tensile stress was assumed to be proportional to concrete tensile strain, no matter how large the strain. Actions were then computed and the section assumed to be cracked. In this case concrete was assumed to have no tensile strength and the actions were again computed.

(vii) Factoring of concrete strains

The reduced and corrected value of concrete strain parallel to the reinforcement, e_c, was factored by 1.0, 1.20 and 1.50 for each load stage for panel sections only. In regions of steep strain gradient, the gauge length of 1" would lead to an average strain value, when in fact the maximum strain was required.

Concrete gauges on the undersides of the panels were thought to suffer most from this effect but this factoring made little difference to the computed actions along panel edge sections and only in uncracked sections away from the edge where strain gradients were probably insufficient to warrant this factoring, was any appreciable difference evident. Special measures had to be taken to obtain more realistic values of panel edge section actions as described below.

(viii) Effect of T- and L-beam flange width

For all beam sections the procedure described above was used to determine the actions on the rectangular

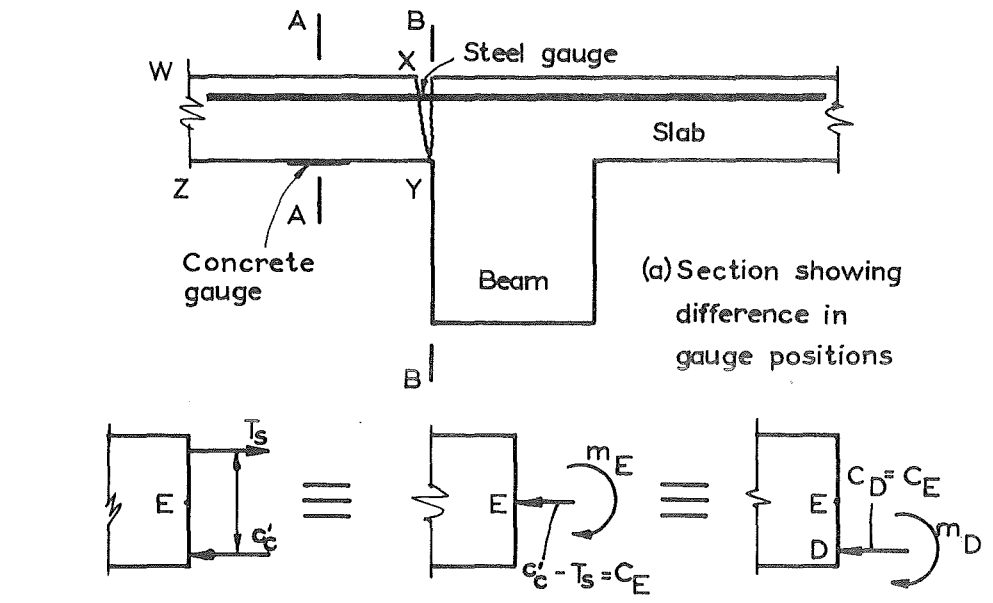
portion of the section only. The effect of flange width was determined by assuming the flange to be of plain concrete and that the strains in the flange sections were the same as those in the rectangular portion at the same level.

Thus from the strain profile of Figure 7.7 the concrete strains at the top and bottom of the flange were calculated and used as input in the subroutine CONACT. For each load stage, total flange widths of 1.0, 2.0 and 3.0 times the web width were used in computing section actions.

7.3.4.2 Modified method for calculation of panel edge section actions

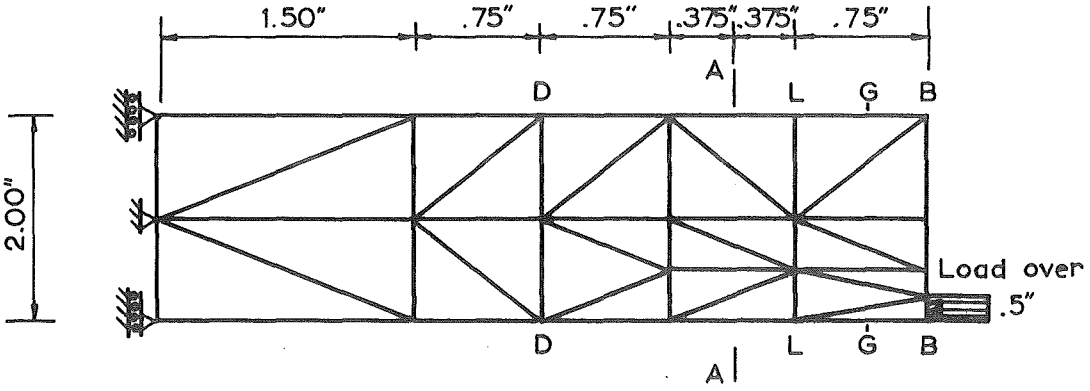
The modified method to be described was necessary because the steel strain and concrete strain measured near a panel edge section did not apply to the same cross-section. This is illustrated in Figure 7.9(a). The steel strain measured corresponded to the cracked section at BB but the concrete strain to the uncracked section at AA. Further, at the end of the test the zone of crushing at Y was no wider than $\frac{1}{8}$", and as the small values suggested, the concrete strain measured was not that existing at Y.

The key to the modified method is given by the forces on the section at BB shown in Figure 7.9(b). The values required were the action at mid-depth, m_E and C_E, resulting from the steel tension T_s and combined steel and concrete compression, c_c. Even for large variations of c_c,



(b) Actions on section BB

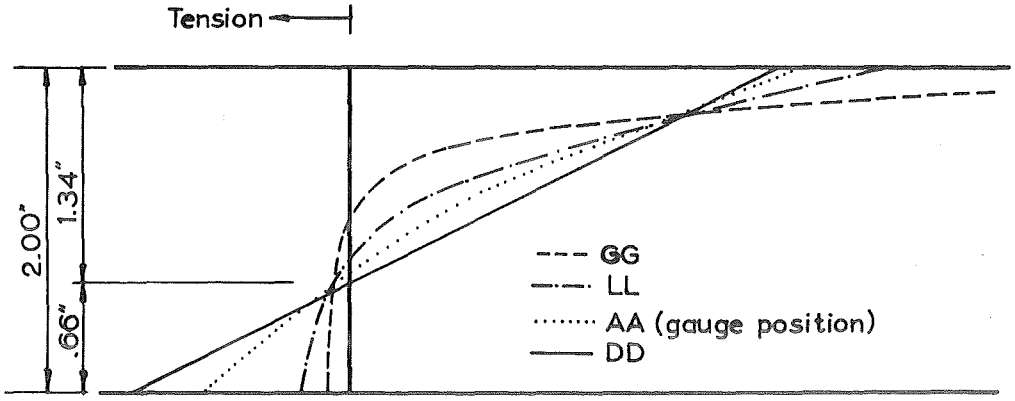
FIGURE 7.9 ACTIONS AT EDGE OF PANEL



(a) Concrete strip element

FIGURE 7.10

(b) Computed strain profiles



the level of its line of action will not alter significantly and may reasonably be assumed constant. The value of m_E, however, is dependent very largely on the magnitude of $C_E = C_D$, the shift in the line of action of c_c being of the second order. Thus, if moments are taken about the assumed line of action of c_c, the magnitude of C_E need not be known for an accurate assessment of m_D to be made.

It is reasonable to assume that the moment and force at Section AA will be equal to those at Section BB. If moments are taken about the level D at Section AA, these should sum to m_D.

On the basis that moments about D, at the level of the bottom steel, are equal at AA and BB it may be seen that

$$(m_D)_{AA} = (m_D)_{BB} = T_s l_a$$

Knowledge of the bottom concrete strain at AA was used to obtain m_E and C_E in two ways as follows.

(a) Assuming full bond transfer of steel force between BB and AA.

If full bond transfer occurs between BB and AA concrete and steel strains at the level of the top steel are equal at Section AA. m_D was calculated from the known steel force at BB. The section at AA was uncracked and the strain profile was found which satisfied the condition that $(m_D)_{AA} = (m_D)_{BB}$ and having the bottom concrete strains

equal to that given by the reduced and corrected value of concrete gauge reading at AA. This was done by increasing the top strain from zero in steps of .000005 until $(m_D)_{AA} = (m_D)_{BB}$. The actions, m_E and C_E for this strain profile were then determined.

(b) Assuming no bond transfer between BB and AA

This assumption meant that at AA, the top steel force was equal to that at BB. A strain profile in the concrete, having the strain at the bottom surface equal to that given by the gauge at AA, may be found such that $(m_D)_{AA} = (m_D)_{BB}$.

Since the contribution of the top steel force to m_D is the same at AA as at BB, the required strain profile would result in the moments of the concrete forces at BB, about the level D, being zero. For D at a level of .94 of the total depth the linear strain profile which gives zero moment of concrete forces about D has $e'_c \approx -2.e_c$ (Figure 7.7) for a material linearly elastic in both tension and compression.

To check the linearity of strain profile, the strip of concrete WXYZ, assumed to be of elastic material, was analysed for a load at Y and the relationship between top and bottom concrete strain at AA was found.

Figure 7.10(a) shows the unit width concrete strip analysed, and the load assumed to be acting upon it. Analysis of this element was done using a library finite

element computer programme, with elements as drawn.

It was found that the strain in the concrete at the top surface was approximately equal to -.5 times the concrete strain on the bottom surface when the strain profile was linear. At AA the strain profile was not precisely linear but very nearly so as may be seen in Figure 7.10(b) which shows the computed strain profiles.

In this case, therefore, the concrete strain profile was calculated directly from $e_c = -\frac{1}{2} e'_c$ where e_c was known, and the section actions computed.

The difference between methods (a) and (b) above was not large and in the analysis of results, values of method (a) were used.

CHAPTER 8

TESTS ON THE PERFORMANCE OF THE METHOD USED TO CALCULATE SECTION ACTIONS

8.1 SUMMARY

In this chapter two types of test on the method used to compute the moment and normal force on a section are described. The first was on a series of three specially cast slab strips with identical strain gauges to those on the model floor. Known actions were applied to the gauged section and these were compared with the values computed from the strain readings.

The second test was on the sensitivity of the actions on a section to change in strain reading in order that the likely effect of electrical drift and other unwanted components of the strain reading could be assessed.

8.2 TESTS ON SPECIAL CONTROL SPECIMENS

8.2.1 Introduction

In order to check the suitability of the method used to compute axial force and moment in slab sections, a series of three slab strips of the same mortar mix used for the model floor was tested. The strips had the same

depth and bottom reinforcement as the model panels. Strain gauges on the steel and concrete were of the same type and mounted in the same way. A range of moments and axial forces was applied to the gauged section. Gauge readings were processed by the method described in Section 7.3 and the computed and applied axial forces and moments compared.

8.2.2 Strip Dimensions and Test Set-Up

Each strip was 36" x 8½" x 1.98" with two ⅛" diameter lead bath annealed bars as reinforcement. The bars were 4¼" apart, symmetrically placed in plan with 3/16" cover at the bottom. Each strip was loaded at the third points of the 33" span.

Vertical load was applied with a screw jack through a proving ring and spreader beam.

At each end of the strip a steel end block was attached, covering both the ends and the end portions of the underside in order to transfer both the vertical reaction and the applied axial compression.

Axial compression was applied by tightening each of the two tie rods. Two diametrically opposite strain gauges on each rod placed parallel to the longitudinal axis provided the means of force measurement, each rod being thoroughly checked and calibrated before and after the tests.

Force in the rods was transferred to the slab strip through beams across the ends. These beams consisted of

two steel flats with a gap for the rods. Force from these onto the end blocks was transmitted through two half-round mild steel pieces for which the end blocks were shaped. This arrangement ensured that the tie rods remained horizontal throughout the test. Figure 8.1 shows the test set up at the end of a test and Figure 8.2 shows strips 1 and 2 after testing.

8.2.3 Instrumentation

The mid-span section of each strip was strain gauged with a gauge on each steel reinforcement bar and a gauge on the top concrete surface above each bar.

Each tie rod had two electrical resistance strain gauges cemented to it which were used to measure axial force. Dial gauges were used to measure the vertical displacement at mid-span and the horizontal movement at the roller support. Proving ring readings provided a measure of the applied vertical load.

8.2.4 Tests Performed

Each load increment represented a combination of moment and axial force at the mid-span section. Increments of proving ring force were 50 lbs giving moment increments of 275 lb-in. Axial force increments were approximately 1000 lb or 118 lb/in width.

Table 8.1 gives a summary of tests performed on the three strips.

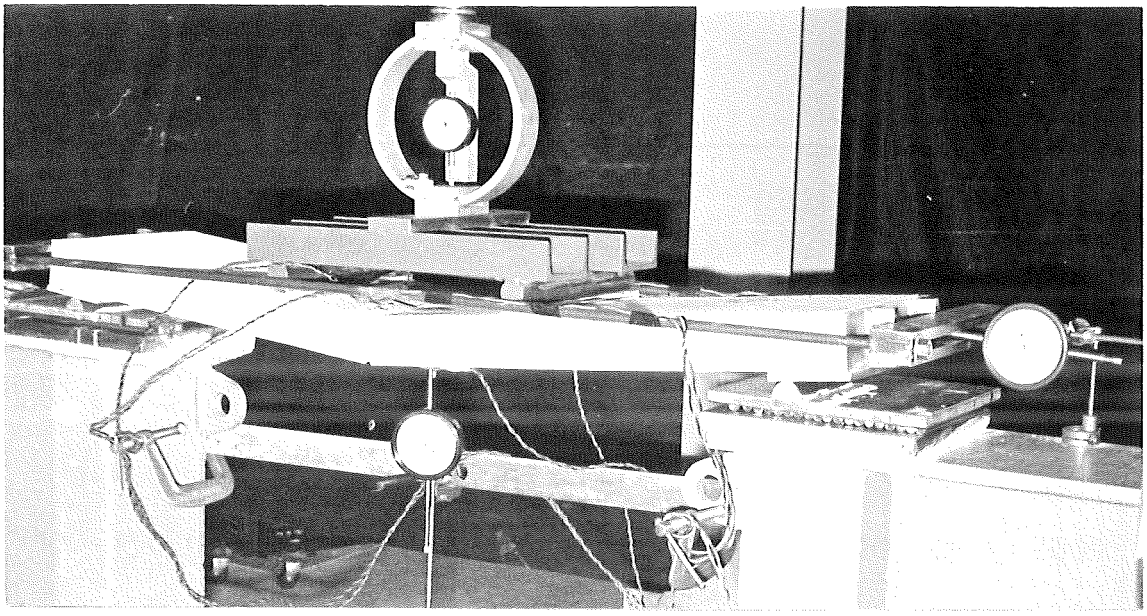


FIGURE 8.1 TEST SET-UP FOR STRIPS

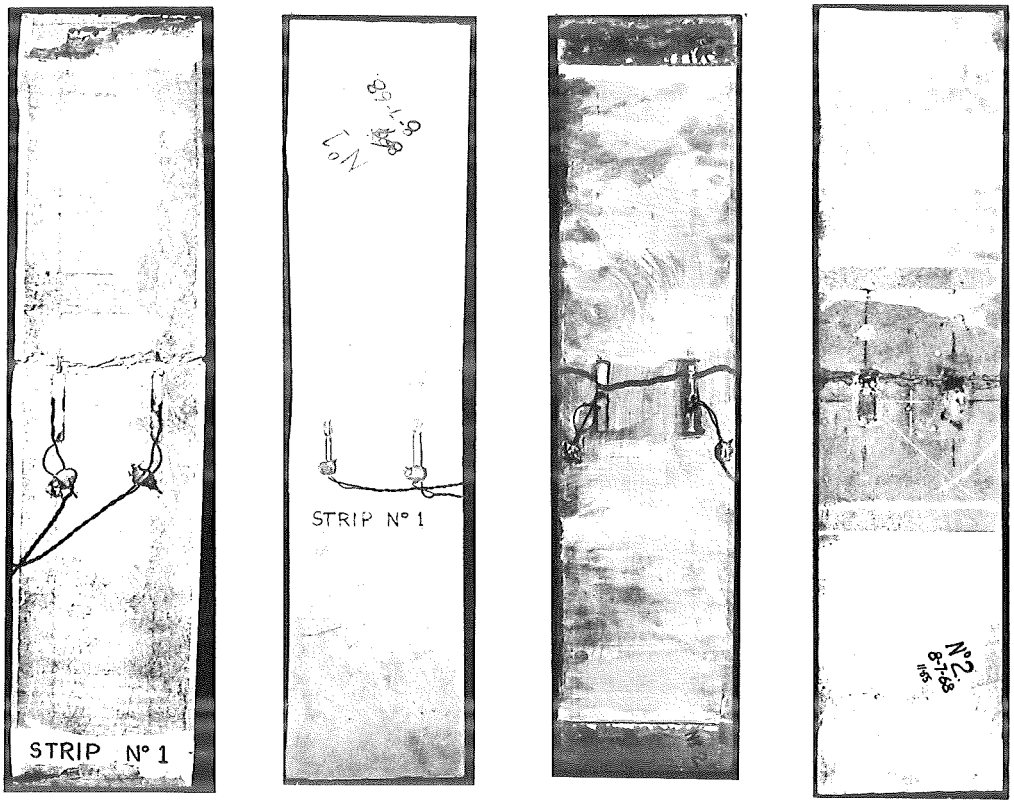


FIGURE 8.2 STRIPS 1 AND 2 AFTER TESTING

Table 8.1. Strip Test Summary.

Strip No.	Load Range lb.	Axial Force Range lb.	Strip No.	Load Range lb.	Axial Force Range lb.	Strip No.	Load Range lb.	Axial Force Range lb.
1	0-450	0-5000	2	0-800	3500-4000	3*	0-700	5000
1*	0	0-5000	2*	0-700	3000	3*	0-600	4000
1*	0-450	5000	2*	0-550	2000	3*	0-500	3000
1*	100-450	0-5000	2*	0-400	1000	3*	0-400	2000
1*	0-400	1000	2*	0-200	0	3*	0-400	1000
2	0-400	0-5000	2*	0-700	2000-4000	3*	0-350	0
2	400-950	5000	3	0-550	0	3*	350-450	0-2000

* Denotes cracked section.

8.2.5 Behaviour During Tests

All strips developed a single crack near mid-span which led to high steel strains. The cracks in strips 1 and 2 did not form directly beneath the centre of the concrete gauges on the top surface and these readings were low as a result. For strip 3 a groove was made in the underside exactly at mid-span. This ensured that the cracking took place at mid-span and that the region of highest concrete strain was near the middle of the gauges.

The very small percentage of reinforcement made the ultimate moment less than the cracking moment and cracking was accompanied by large increases in steel strain, especially when the applied axial force was low.

When the vertical load was increased for a set value of axial force, the outward spread of the ends caused an increase in axial force, but only in cases where variation became large was any adjustment made.

8.2.6 Results

Only the comparison of calculated and applied values of moment and normal force is presented in this Section. The full results are given in Appendix F.

(a) Determination of Applied Actions:

Moment at the mid-span section about its mid-depth was computed from the three components: (i) Dead load moments, including allowance for the weight of the proving ring and spreader beam; (ii) Moment induced by the vertical applied load and (iii) Moments induced by the eccentricity of horizontal force applied at the ends of the strip.

(b) Determination of Section Actions from Strain Readings:

The method of Section 7.3 was used. Section strain values were taken as the average of the two taken on the steel and on the concrete. Both the normal method and the second modified method (Section 7.3.4) were used in this analysis. For strip 3, the normal method was used since the crack formed exactly at mid-span but for strips 1 and 2, cracking was not exactly at mid-span and a situation

similar to that described in Section 7.3.4.2 arose whereby concrete strain readings greatly underestimated the maximum concrete strain. The second modified method, in which no bond transfer was assumed, was used.

(c) Comparison of Applied and Calculated Section Actions:

Figures 8.3 and 8.4 show graphically the results of this comparison. In Figure 8.3(a), the ratio of calculated moment to applied moment is plotted against applied moment for the uncracked sections.

Results from each strip are recorded, and for strips 1 and 2, values of the ratio for applied axial compression, N_{app} = 0 and N_{app} = 5000 lb are given for each level of M_{app}.

Figure 8.3(b) is a similar plot for the ratio of calculated and applied normal forces, N_{calc}/N_{app} for an uncracked section. For each value of N_{app}, the ratio is plotted for M_{app} = 330 lb-in and M_{app} = 2550 lb-in.

Figure 8.4 shows similar plots for a cracked section. The range of normal force and moment was not as great as that applied before cracking and less points are shown.

Because the cracks were close to the gauge, the results of strips 1 and 2 after cracking were calculated with a linear strain profile approximating that given for Section GG of Figure 7.10. For this the strain at the level of the bottom surface was taken as -1.8 times the top surface

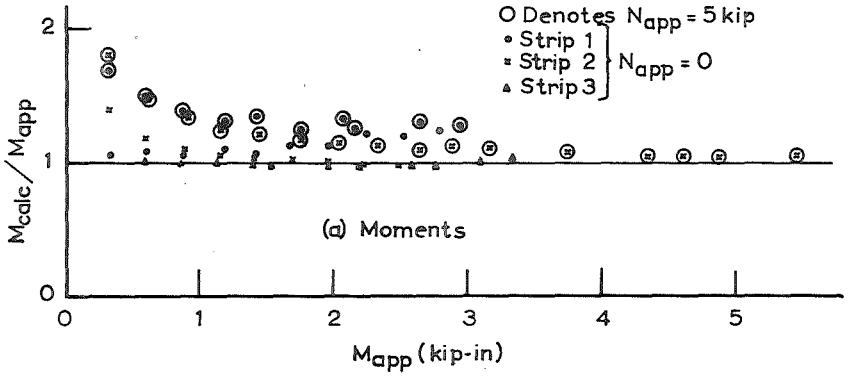
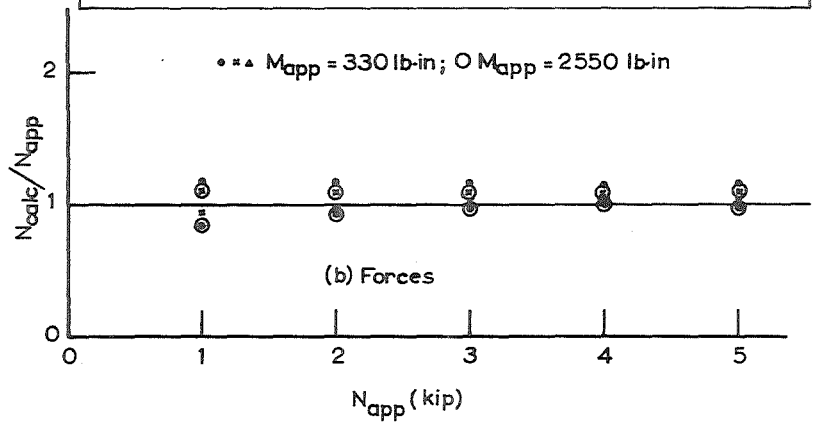


FIGURE 8.3 ACTION COMPARISON BEFORE CRACKING



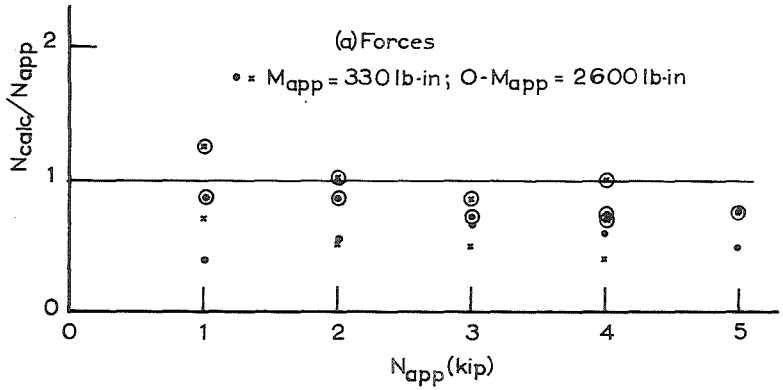
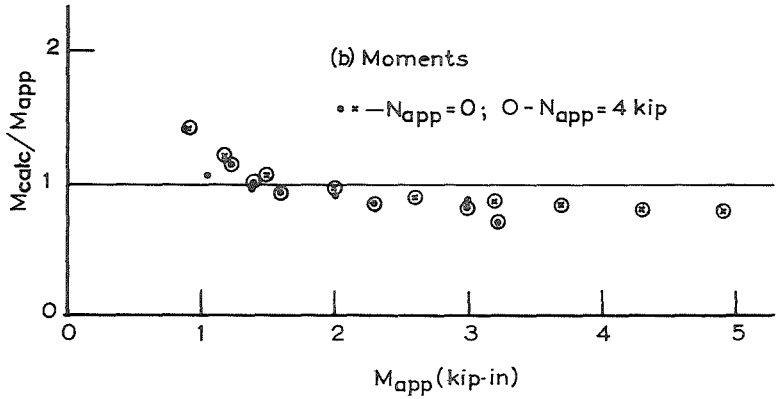


FIGURE 8.4 ACTION COMPARISON AFTER CRACKING



strain reading.

Further evidence of good correlation of results for strips 1 and 2 is given in Figure 8.5. This shows plots of moment, both calculated and applied, versus proving ring force. The results cover tests on strip 2 in which the proving ring force was increased with the applied compression set at 2000 lb and later 3000 lb, and a similar test for strip 1 for N_{app} = 1000 lb.

8.2.7 Discussion

Results from all strips before cracking showed agreement within $\pm$ 20 per cent for most cases, many of which corresponded to within 10 per cent. Before cracking, strain was easier to measure in that the effect of finite gauge length was not as great as after cracking. This led to more accurate calculation of section moments and forces but the low values of strain at this stage made the effects of electrical drift and other strain reading errors relatively greater.

The position of the crack in relation to the concrete gauges was obviously significant. For strips 1 and 2 where the cracks did not form at the gauge points, it was possible to obtain good correlation of applied and calculated values of section actions. These were still dependent on the position of the crack since it was shown that the strain profile across a section near the crack was not linear. By taking account of this factor, satisfactory

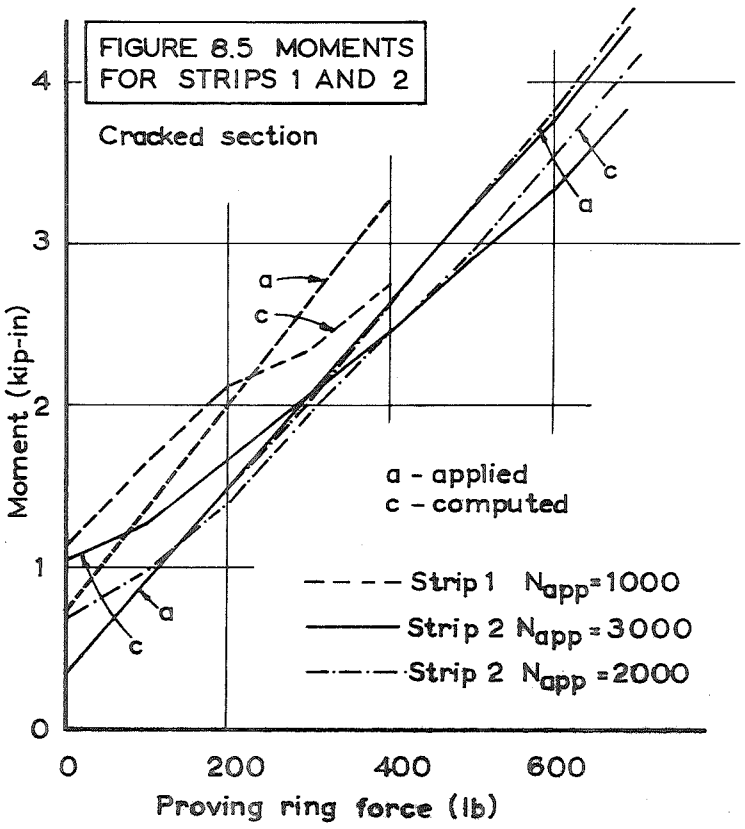


FIGURE 8.5 MOMENTS FOR STRIPS 1 AND 2
Cracked section
Moment (kip-in)
Proving ring force (lb)
a - applied
c - computed
Strip 1 Napp=1000
Strip 2 Napp=3000
Strip 2 Napp=2000

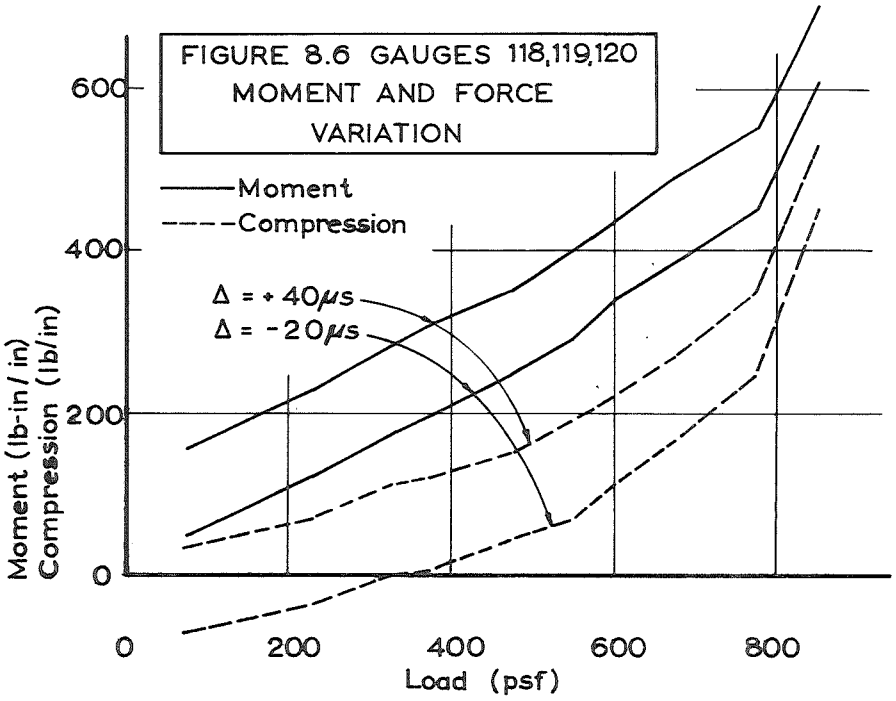


FIGURE 8.6 GAUGES 118,119,120 MOMENT AND FORCE VARIATION
Moment
Compression
Δ = +40μs
Δ = -20μs
Moment (lb-in/in) Compression (lb/in)
Load (psf)

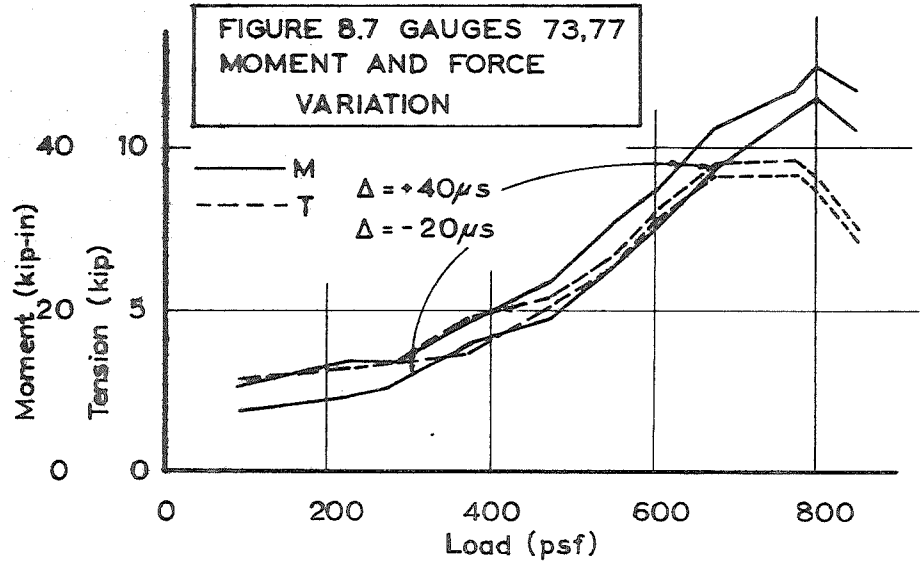


FIGURE 8.7 GAUGES 73,77 MOMENT AND FORCE VARIATION
M
T
Δ = +40μs
Δ = -20μs
Moment (kip-in)
Tension (kip)
Load (psf)

correlation of results was achieved, especially for strip 2 where the crack corresponded almost exactly to the end of the concrete gauges.

The results of strip 3 did not compare as favourably. The measurement of concrete strain directly above the crack was not simple because of its rapid variation along the gauge length.

This method of calculation of panel section action could be expected to give results within approximately 30 per cent of actual values.

In assuming the applicability of this conclusion to results of the model floor, the following points must be borne in mind:

(i) For the uncracked sections of the model the variation of strain reading due to electrical drift and other time effects may have had a significant effect.

(ii) For sections at the panel edge the concrete gauges were at a considerable distance from the cracked section and therefore the assumption of a linear strain profile for the concrete afforded a closer approximation to actual behaviour than a similar assumption used for these strip tests.

(iii) Each strip was tested over a period of several hours. Strain reading errors introduced by time-dependent effects in the slab model test may therefore have been greater than in the strip tests.

8.3 THE EFFECT OF VARIATION IN STRAIN READINGS

Of importance in the interpretation of results is the sensitivity of the values calculated to change in strain reading.

Considerable variation in strain readings between the end of one test and the beginning of the next test on the following day was detected and although this was accounted for in reducing readings, it pointed to the possibility of appreciable discrepancies between strain readings and the true strain due to stress alone. In order to examine the effects of strain reading variation on the section actions, four typical sections were chosen and the raw readings of steel and concrete gauges varied from the actual values. The resulting moments and forces were compared.

The four sections taken were as follows:

Gauge Numbers	Description of Section
118, 119, 120	Centre panel edge, modified method used on cracked section.
8, 10	Centre panel span, normal method used. Section uncracked almost throughout test.
73, 77	Interior beam, centre span, at mid-span, normal method used.
126, 129	Interior beam, centre span, at support, normal method used.

Four runs were performed for each section using different values of strain deviation, Δ. In each run the value, Δ, was subtracted from datum-corrected readings of concrete

strain gauges and added to datum-corrected readings of steel strain gauges. The four values of Δ used were: -20, 0, +20, +40 microstrains.

Results are compared graphically in Figures 8.6 to 8.9 inclusive. These show the increase of section actions with increasing load after load stage 168.

At 775 psf the ratio of moment or normal force for Δ= +40 to the moment or normal force at Δ= -20 had the following values:

Section	Ratio M_{max}/M_{min}	Ratio N_{max}/N_{min}
118, 119, 120	1.23	1.40
8, 10	1.40	1.60
73, 77	1.05	1.04
126, 129	1.08	1.07

The curves shown represent a variation of 60 microstrain in both concrete and steel strain. The fact that steel strain was increased and concrete strain decreased could be expected to produce a greater effect on the moments than on the axial forces.

Variation in the panel sections was greater than in the beams. Gauges 118, 119 and 120 were at a centre panel edge section where the modified method of computation was used. The 60 microstrain variation in this case is a large proportion of the measured concrete strain. The same is true of the section at gauges 8, 10 which did not crack

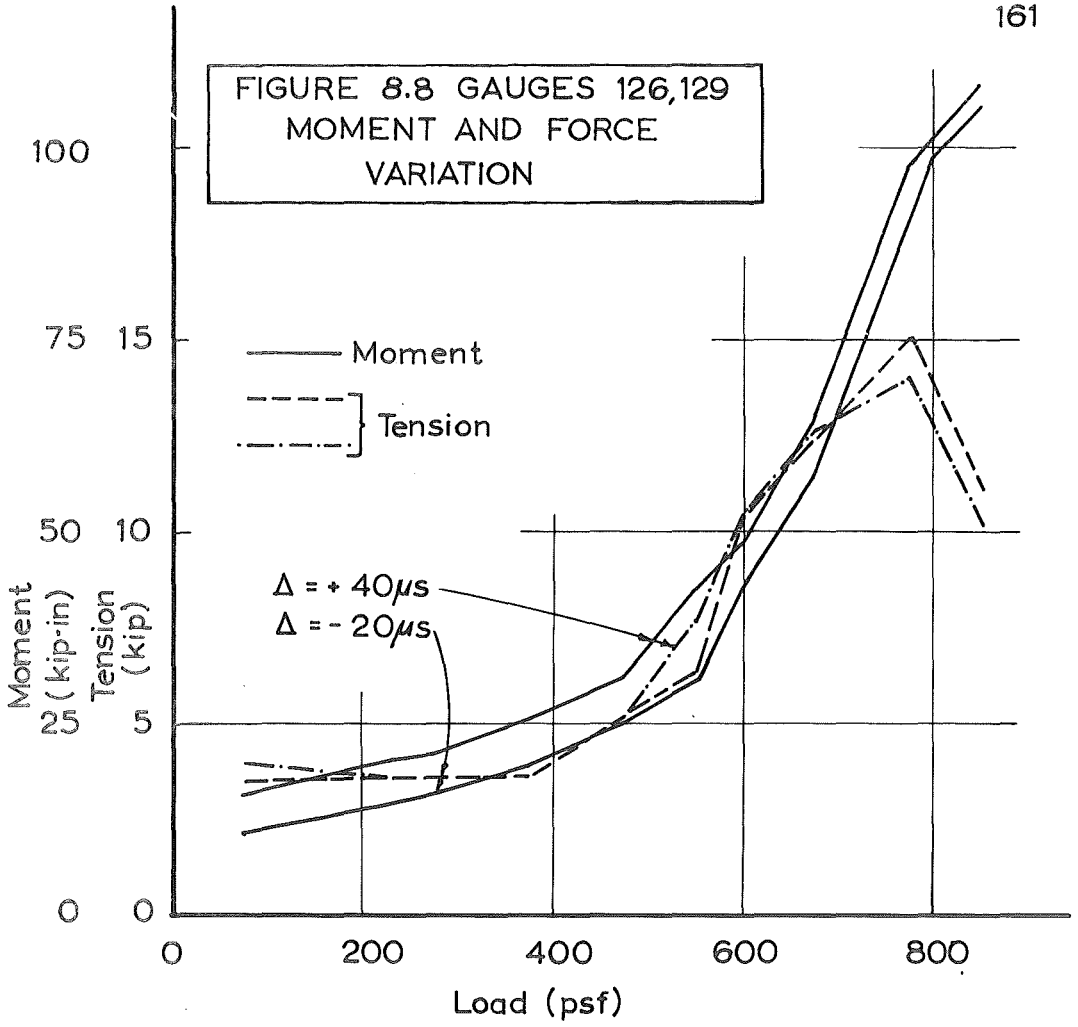


FIGURE 8.8 GAUGES 126,129
MOMENT AND FORCE
VARIATION
100
75
50
25
0
15
10
5
0
Moment (kip-in)
Tension (kip)
Moment
Tension
Δ = + 40μs
Δ = - 20μs
0
200
400
600
800
Load (psf)

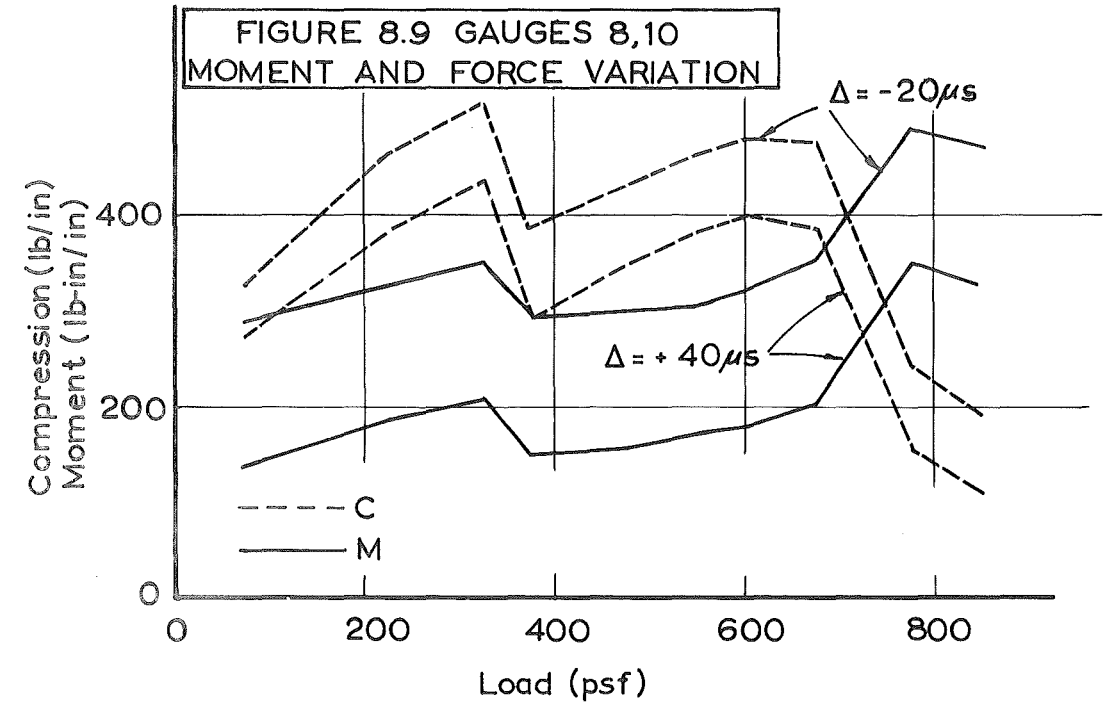


FIGURE 8.9 GAUGES 8,10
MOMENT AND FORCE VARIATION
Compression (lb/in)
Moment (lb-in/in)
400
200
0
Δ = - 20μs
Δ = + 40μs
C
M
0
200
400
600
800
Load (psf)

until late in the test. The variation of moment (23 per cent and 40 per cent) and of normal force (40 per cent and 60 per cent) for the 60 microstrain variation indicates the appreciable sensitivity of the computed actions to strain reading variations. For this same strain variation, the beam actions show markedly less change. The variation of less than 10 per cent in these actions due to the 60 microstrain variation is clear evidence of their insensitivity to such change.

The magnitude of likely strain variation in the slab test is difficult to determine exactly but variations in the temperature and zero gauges during the test suggested that 30 microstrain would be an upper limit. Most of the actions computed from strain readings during the test would therefore vary by less than one half of the above values.

CHAPTER 9

BEHAVIOUR OF THE NINE-PANEL MODEL FLOOR DURING THE TEST PROGRAMME

9.1 SUMMARY

This chapter describes the behaviour of the floor during the test programme in terms of the strains, deflections, loads and reactions measured at each load stage, and the examination, during and after the test, of physical effects such as cracking. The floor had been designed for an ultimate load of 800 psf including membrane action. This load was twice the Johansen ultimate load of the centre panel, 1.35 times the Johansen load of the centre-edge panels and equal to the Johansen load of the corner panels. Pattern loads were applied in early test runs but beyond 400 psf all panels were loaded equally until the centre panel failed at almost 850 psf, a failure brought about by the transition of the panel from a state of predominantly compressive membrane action to one of predominantly tensile membrane action. The outer panels were intact at this stage. Following the failure of the centre panel the load fell to 540 psf. Load on all panels was then increased to 710 psf at which time the centre

panel loading bag was in danger of bursting through the full depth cracks which had formed at the centre of the panel. Load on the centre panel was then reduced to 600 psf and the load on all outer panels increased to 960 psf when the centre-edge panels failed in a combined panel and beam mechanism. The centre-edge panels were held at 960 psf while the loading on the corner panels was increased. The end spans of the interior beams developed plastic hinges at 1170 psf* and the test was stopped at this load with panel failure mechanisms in the corner panels incompletely developed.

Symmetry of behaviour was excellent throughout the test programme until after the centre panel failure. During the loading to failure of the outer panels the plastic hinges in the end spans of the interior beams did not develop simultaneously and the symmetry was upset noticeably.

Reactions were not affected greatly by moment redistribution and values remained close to those expected. Summation of reaction values indicated that the loading bags applied load over only 90 - 95 per cent of the total top floor area due to rounding of the bag edges.

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* Figures quoted indicate the intensity of load applied to the panels of the model floor. This includes the 75 psf difference between prototype and model self weights but does not include the self weight of the model (= 25 psf).

Compressive membrane action enhancement was exhibited by all panels. Measured compressions at the edge of the centre panel were of the order used in design and beam tensions in the centre spans of the interior beams were accordingly large. Tension in the exterior beam centre spans indicated the presence of compressive membrane forces in the long direction of these panels as expected. Forces measured along the interior long edge, parallel to the short side, were large enough to suggest considerable membrane action in this direction. Beam tensions in the centre spans of both interior and exterior beams were large and may have been larger if all panels had failed simultaneously. Values were higher at the support than at mid-span.

Initial cracking of the undersides of the outer panels produced a marked effect on the centre panel. The loss of lateral restraint caused an increase in deflection and strain values in the centre panel. Stability during 66 hours of sustained loading at 375 psf was good but instability was evident at 550 psf when the undersides of the corner panels cracked for the first time and cracking of the centre-edge panels extended.

The effect of membrane action on the torsion in the edge beams was evident in the slow increase in strain in the panel reinforcement at the sections adjoining the beams. Torsional deformation in the beams was not large

until after the centre panel had failed and the end spans of the interior beams had developed large cracks prior to the full development of plastic hinges there.

Moments along lines traversing the whole floor were calculated from reactions and applied loads. The rise with load of the 'free' moment so calculated was linear and agreed well with the expected value throughout the test. Initially, moments along mid-span sections were relatively high in comparison with the support values but as load increased, the rate of increase of mid-span moment fell and a corresponding rise in the rate of increase of support moment took place.

Moments at beam sections computed from the strain readings showed a similar trend. The line moments, calculated from the sum of beam section moments, showed satisfactory agreement with those calculated from the reactions and applied loads. The effect on line moment calculations of the net beam tension and net slab compression was large since each force was taken to act at a different depth below the top surface of the slab. The two forces thus formed a couple which had to be taken into account.

The rate of increase of compression at the edges of the centre panel was similar to that of the increase in supporting beam tension, being small at low load levels and increasing with load.

Although strain readings afforded some measure of panel and beam section forces and moments which in many cases compared satisfactorily with values determined by other means, the accuracy of the results was not sufficient to distinguish any difference in centre panel behaviour with varying load pattern. Only the variation of steel strain at the middle of the centre panel showed signs of the surround being slightly stiffer laterally when the outer panels were not loaded fully.

Deflections at DL + LL* were small for all components with the centre panel showing greatest deflection to span ratio. This ratio first exceeded L/360 at 450 psf when considerable surround stiffness loss occurred with the initial cracking of the underside of the centre-edge panels. This loss and the extended cracking of the centre panel caused appreciable unrecoverable deflections.

Strain levels were also low at DL + LL. At this load, after the floor had been loaded to a maximum of 450 psf, strains at the panel edges ranged up to two-thirds of yield values. Steel strains in the beams were approximately one half yield values. The application of 450 psf had yielded the steel at the middle of the centre panel.

At the stage of failure of the centre panel most of the beam steel had yielded or was near to yield, and steel

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*The abbreviation DL denotes the prototype dead load = 100 psf
" " LL " " " live " = 300 psf

at the edge of the panel was well beyond yield. Panel edge steel along the exterior beams, however, showed very small values of strain.

Panel deflections at this stage were large in both centre-edge and centre panels though rapid increase had not commenced until 600 psf. The deflections of the centre spans of all beams were less than 1/360 of the span and other beams deflected little in excess of this.

The applied load of almost 850 psf at the stage of failure of the centre panel was 10 per cent in excess of the design ultimate load.

Details of slab behaviour follow in the next two sections. In Section 9.2 the behaviour of the floor during each of the 14 tests performed is described. Although chronological order of testing is not strictly adhered to, this section is intended to give a clear impression of the floor behaviour as the test progressed and to indicate the effect of different load patterns.

A more detailed analysis of particular aspects of the floor behaviour is given in Section 9.3 which deals mainly with all-over load. Deflections, strain readings, cracking, reactions, moments and membrane action effects are dealt with in turn.

9.2 TEST BY TEST DESCRIPTION OF FLOOR BEHAVIOUR

9.2.1 Tests 101, 102, 105 and 106

In these tests the slab was loaded over its whole

surface to a maximum of dead load plus full live load (375 psf applied).

9.2.1.1 General

Tests 101 and 102 (to DL + $\frac{1}{2}$LL) were preliminary tests only, serving to test the loading system, data recording devices and the symmetry of response. Embedment of the load cell ball bearings into the mild steel bearing plates caused differential settlement of the reaction points and redistribution of reactions. This, and the tendency for the corners to lift made resetting of the reactions necessary after Tests 101 and 102. No further adjustment was made.

Test 105 was a repeat of Tests 101 and 102, performed after the pattern load tests (103 and 104) had been performed.

In Test 106 the load was increased to DL + LL before being released in stages.

9.2.1.2 Deflections

Load-deflection relations were linear for all vertical deflection gauge points. In Tests 101 and 102 full recovery was not achieved due to the embedment of the load cell bearings into the mild steel bearing plates. Deflection levels in Tests 101, 102 and 105 were very low.

The maximum deflections occurred in Test 106 when DL + LL was applied. Values of the largest deflection

occurring within each of the element type groups are given below (Table 9.1).

Table 9.1. Deflection at Load Stage 85 (375 psf).

Element Type	Reference Mark (Figure 6.2(a))	Maximum Deflection (inches)	Deflection: Span (ratio)
Interior Beam	Beam NS3	.0285	1:2190
Exterior Beam	Beam NS1	.0154	1:4050
Corner Panel	Panel C	.0210	1:2120
Centre-edge Panel	Panel H	.0403	1:1100
Centre Panel	Panel G	.0616	1:1012

9.2.1.3 Membrane Action Effects

There was no cracking of the underside of the centre panel during these tests but the cracking at the edges could be expected to cause the development of compressive membrane forces normal to the edge. Tension in the beams was not high but compressive membrane forces were appreciable. Figure 9.1 shows the increase of this edge compression during Test 106.

9.2.2 Tests 103 and 108

9.2.2.1 General

In both these tests the load on the centre-edge panels was held at 75 psf while the centre and corner panels were loaded to 225 psf (DL + .5LL) in Test 103 and

to 400 psf (DL + 1.08LL) in Test 108.

9.2.2.2 Deflections

With one exception the deflections of beams and panels were smaller than those occurring at LS85 (see Table 9.1). The cracking of the underside of the centre panel which took place during Test 107 produced non-recoverable deflections and the maximum deflection to span ratio rose to 1:678.

9.2.3 Tests 104 and 109

In Test 104 the centre-edge panels only were loaded to 225 psf, while the load on the other panels was maintained at 75 psf.

In Test 109 the load was taken up to 375 psf on the centre-edge panels. The load on the other panels was kept at 75 psf until, at a load of 250 psf on the centre-edge panels, when the corner reactions were about to become zero, the load on the other panels was increased to 200 psf to ensure that the corner points of the floor did not lift off their supports. When 375 psf was reached on the centre-edge panels the load on the other panels was reduced from 200 to 150 psf at which stage the corner reactions were again nearly zero. This latter condition represented the most severe loading applied during Test 109. Test 104 brought no further cracking but in Test 109 cracks appeared near the centre of the middle spans of the exterior beams

NS4 and EW1. Deflections during both tests were not large.

9.2.4 Tests 107, 110 and 111

9.2.4.1 General

The loading sequence in these tests was designed specifically to examine the behaviour of the centre panel in the presence of reduced load on the surrounding panels, the effect of reduced edge moment restraint and modified surround stiffness being of particular interest. Time dependent effects were examined during two periods in the course of these tests.

The whole floor was loaded to a maximum of 375 psf in Test 107. This was followed by reduction of the load on all but the centre panel to 75 psf, the original condition of 75 psf all over then being achieved by reduction of the centre panel load in stages.

All panels were loaded equally in Test 110. The applied load was first increased to 450 psf, reduced then to 375 and held for 22 hours and then reduced to 75 psf.

In Test 111 the load on all panels was taken up to 225 psf, the centre panel load then being raised to 375 psf and reduced again to 225 psf. All panels were then loaded to 375 psf and held at this load for 66 hours while time-dependent effects were examined.

9.2.4.2 Deflections

Cracking produced by the higher load levels caused

larger deflections than in previous tests. Much of the deformation in the centre panel was not recovered on release of load. The effect of cracking is clear from the examination of the maximum element deflections for each test (see Table 9.2) but the different load conditions must be taken into account in making any comparison.

Table 9.2. Maximum Deflections of Elements for Tests 107, 110 and 111.

Element Type	Reference Mark (Figure 6.2(a))	Test No.	Maximum Deflection (inches)	Span: Deflection (ratio)
Interior Beam	NS3	107*	.0305	2040
	EW3	110**	.0550	1140
	EW3	111***	.0470	1330
Exterior Beam	NS1	107	.0169	3700
	NS1	110	.0399	1570
	NS1	111	.0309	2020
Corner Panel	J	107	.0219	2030
	J	110	.0305	1460
	J	111	.0197	2260
Centre-edge Panel	F	107	.0380	1170
	F	110	.0732	610
	D	111	.0546	810
Centre Panel	G	107	.0871	720
	G	110	.2166	289
	G	111	.2137	294

* 375 psf on centre panel; 75 psf on all others.
** 450 psf on all panels.
*** 375 psf on centre panel; 225 psf on all others.

The effect of the application of 450 psf (75 psf in excess of the design service load) on the centre panel

deflections was very marked. The maximum deflection of the centre panel before design service load was exceeded was only 1/600 of the span.

9.2.4.3 Cracking

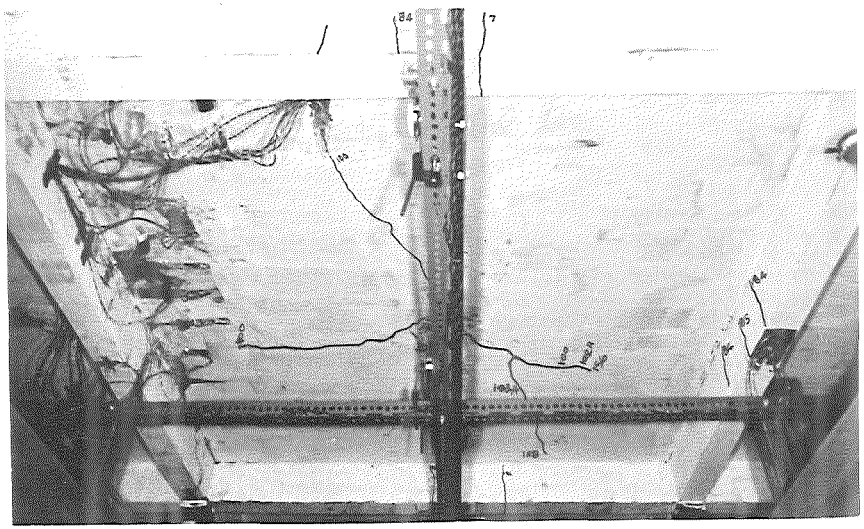
Cracking in the centre spans of beams and in both the centre and centre-edge panels took place during these tests.

First cracking of the underside of the centre panel occurred when the load on the outer panels was reduced to 275 psf and left for one hour (LS100). Three cracks radiated from the centre and extended well towards the edges of the panel (see Figure 9.2 (a)). On further reduction of outer panel load, considerable extension of one of these cracks took place. The maximum crack width in the centre panel, measured when the load on the outer panels was 75 psf, was .002".

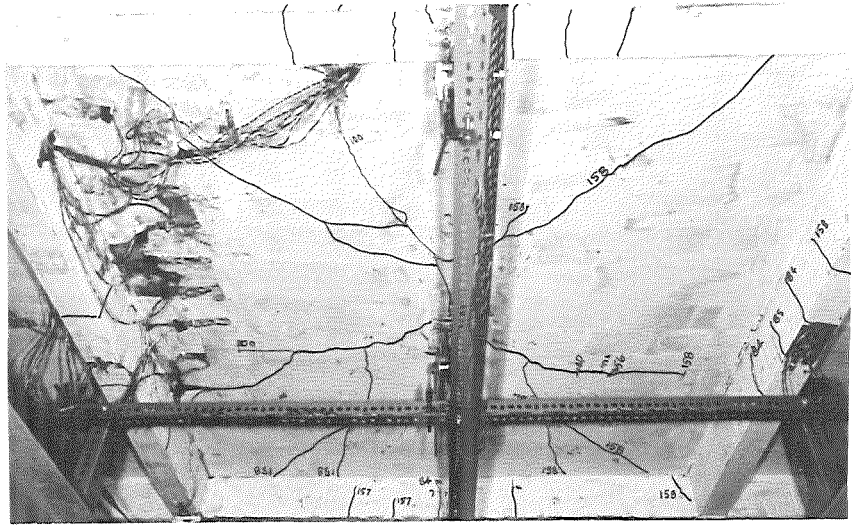
The maximum load of 450 psf (DL + 1.25LL), applied in Test 110, produced further cracking in the centre panel, in the centre spans of all beams and caused the initial cracking of the underside of the centre-edge panels.

At 400 psf and 425 psf (LS156 and 157) small extensions in the centre panel cracks were noticed and the maximum crack width was .003". Some new cracks appeared in the centre spans of interior beams.

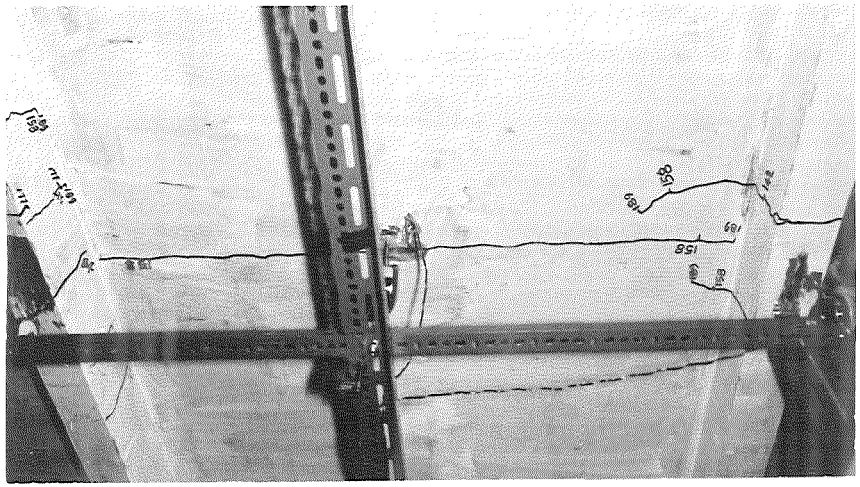
At 450 psf (LS158) cracks formed in all elements except the corner panels and their supporting spans. In the middle of each centre-edge panel a crack ran the full



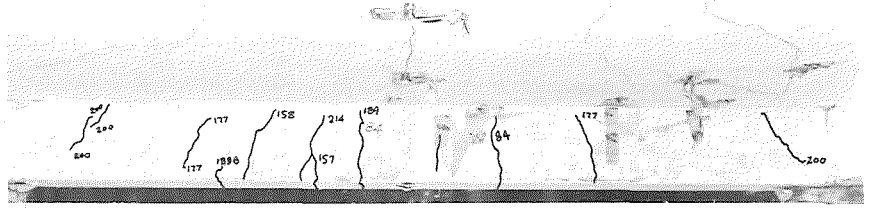
(a) Centre Panel - Test 107 - 375 psf



(c) Centre panel - Test 110 - 450 psf



(b) Centre-edge panel - Test 110 - 450 psf



(d) Interior beam, centre span - 550 psf

FIGURE 9.2 CRACKING DURING TESTS 107, 110 AND 111

width, parallel to the short sides, and in one panel two smaller cracks formed in the L-beam flange, either side of mid-span (Figure 9.2(b)).

Cracking at the supports of the centre spans of the NS interior beams was noticed for the first time and several new cracks appeared at the middle of these spans.

Each centre-edge panel crack caused increased cracking in the centre panel and since an appreciable time elapsed before all four centre-edge panels had cracked, a similar time passed before cracking of the centre panel ceased. Comparison of Figures 9.2(a) and 9.2(c) reveals the extent of cracking in the centre panel produced by this load increment. Figure 9.3 shows the crack pattern for the whole slab at this stage.

New cracks appeared in Test 111 at load stage 177 in some beams supporting the centre panel. In beam EW3 two steeply inclined cracks (marked "177" in Figure 9.2) appeared at the third points of the centre span. One of these did not extend to the bottom of the beam.

Further, smaller cracks of a similar nature appeared after the load of 375 psf on all panels had been maintained for nine hours. After 21 hours very few new cracks had formed and after 29 hours the extension of existing cracks was negligible.

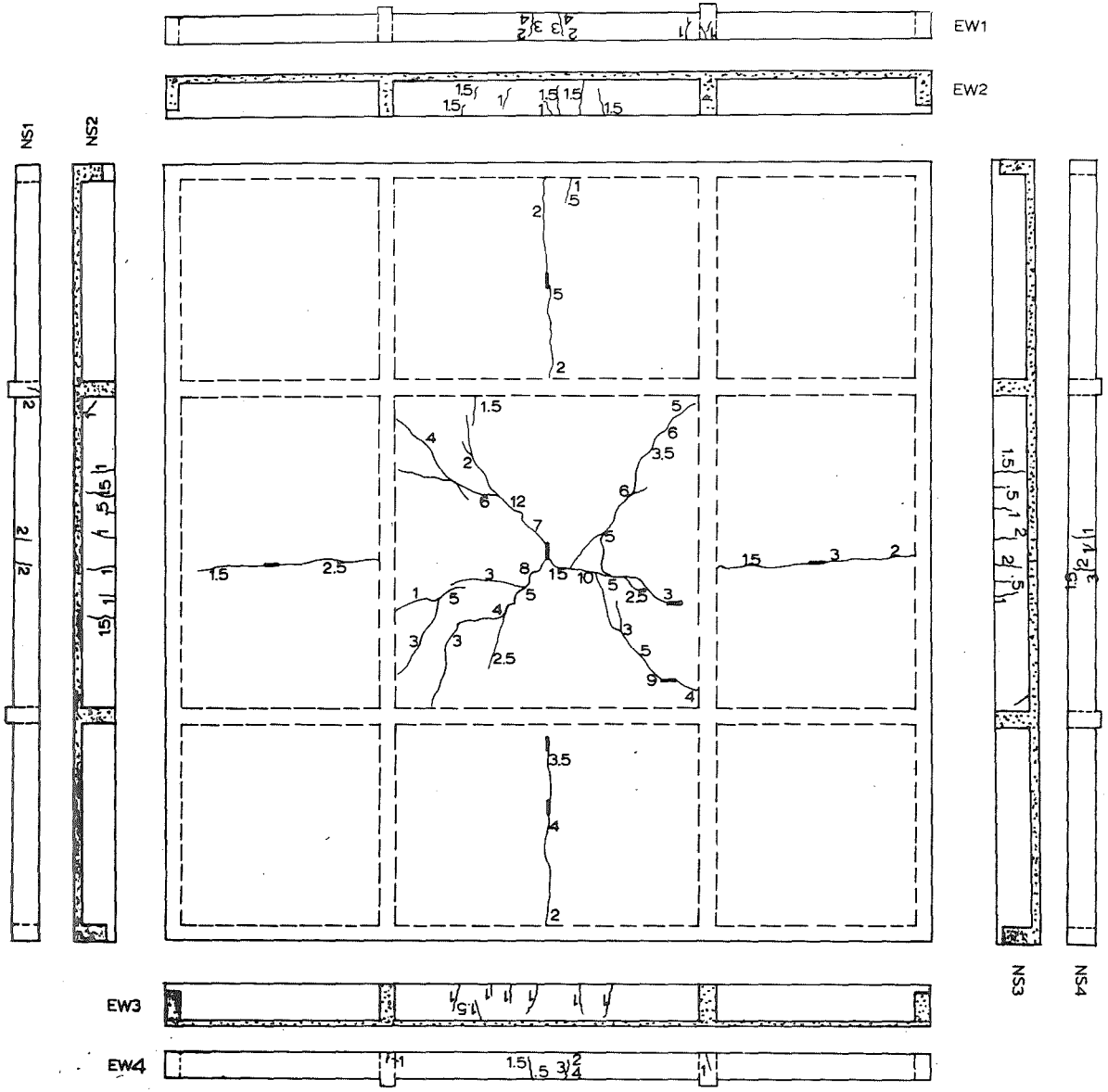


FIGURE 9.3
CRACK PATTERN AS AT 450 PSF APPLIED LOAD

Maximum crack widths shown in .001" units for load at 375 psf.

9.2.4.4 Strain, Moment and Normal Force Levels at Maximum Load

Table 9.3 shows the values of strains and computed moments and normal forces for four critical load stages.

Load stage 98 preceded the first cracking of the underside of the centre panel and much of the beam cracking. Strains are low as a result. The effect of the application of 450 psf at LS158 was to increase steel strains sharply, particularly in the centre panel. At both panel and beam sections, sharp increases were evident in the values of moments and mambrane forces.

Loads applied in Tests 111 produced relatively little change.

9.2.4.5 Membrane Action Effects

Small changes in beam tensions and panel membrane forces resulted from the removal of load from the outer panels in Test 107.

The difference in behaviour between the load configuration in Test 111 and that in which load was applied equally to all panels was not large enough to be detected.

The most vivid expression of membrane action came in Test 110 with the application of 450 psf when the loss of surround stiffness resulting from the cracking of the centre-edge panels caused a marked change in the behaviour of the centre panel. The cracks in the centre-edge panels (Figure 9.2(b)) ran along radial lines from the centre of

TABLE 9.3 - STRAINS, MOMENTS AND NORMAL FORCES AT LOAD STAGES 98, 158, 176 and 189

ELEMENT	GAUGE	POSITION	GAUGE NO'S	MAXIMUM CONC. STRAIN				MAXIMUM STEEL STRAIN				MOMENT (Kip-in and lb-in/in)				FORCE (Kips and lb/in)			
			LSN	98	158	176	189	98	158	176	189	98	158	176	189	98	158	176	189
Ext. Beam	C.Span	Support	133,134	-143	-246	-182	-225	89	303	231	297	-3.6	-13.0	-10.5	-13.1	-2.9	-2.4	-1.7	-2.3
Ext. Beam	C.Span	Mid-Span	53,55	-70	-76	-20	-45	94	534	486	508	6.4	7.5	4.5	5.8	-.9	1.4	1.9	1.6
Ext. Beam	E.Span	Mid-Span	59,62	-45	-63	-31	-51	40	53	21	50	4.6	+3.2	-.3	1.7	-2.6	-4.9	-4.5	-5.1
Int. Beam	C.Span	Support	126,129	-97	-163	-75	-124	106	409	371	423	-13.6	-23.6	-17.9	-21.7	-.5	2.7	3.9	3.5
Int. Beam	C.Span	Mid-Span	73,77	-68	-92	-31	-50	339	596	504	549	12.4	18.6	13.8	15.2	1.9	4.0	4.0	3.9
Int Beam	E.Span	Mid-Span	64,67	-44	-63	-38	-59	102	109	164	101	7.4	5.5	1.9	4.5	.5	-1.8	-2.6	-2.7
Centre Panel	Centre	Bottom	6					279	1650	1575	1638								
Centre Panel	Edge		114,115	-54	-52	-14	-18	306	1441	1305	1422	-114	-141	-88	-97	-76	73	115	117
Centre Panel	Edge		118,119	-117	-161	-115	-128	338	1431	1261	-1390	-206	-300	-226	-257	-178	-109	-106	-67
Centre Panel	9" from Edge		20,22	40	62	61	73	-38	-91	-98	-110	-74	-171	-169	-189	-74	-207	-213	-220
Edge Panel H	Centre	Bottom	5					39	-3	-42	-13								
Edge Panel H	Edge	Int.Long	94,95	-108	-182	-107	-133	172	719	681	776	-188	-302	-197	-239	-181	-232	-121	-158
Edge Panel H	Edge	Ext.Long	97					8	16	-29	-13								
Edge Panel H	Edge	Short	102					195	390	328	404								
Corner Panel	Edge	Int.	91					246	870	780	919								
Corner Panel	Edge	Ext.	86					14	12	-21	-1								

All Strains Corrected for Drift (Gauge 81) and 100 PSF Initial Load.

Steel Strains Corrected for Temperature (Gauge 140).

Moments and Forces Calculated From Strains Shown.

Refer to Figures 7.2 and 7.3 For Gauge Positions.

the floor. This, and the presence of more cracks towards the outside edge indicated that these panels were acting as deep beams and ties against the compressive membrane forces in the centre panel. Each of these long cracks was seen to produce immediate and sharp deterioration of centre panel behaviour.

9.2.4.6 Effects of Sustained Loading

At two stages during these tests, design service load was maintained on all panels for an appreciable time. The application of 375 psf for 22 hours at LS161 revealed negligible time effects, but the 66 hours at this load (LS189) produced detectable changes.

Figure 9.4 shows deflection in the centre panel, steel strain at its edge and steel strain at the mid-span section of an interior beam plotted against time for LS189. The effect at zero time has been set to zero for each curve and steel strains have been corrected for temperature variation. The total increases over the 66 hours are small and a general trend towards stability with time is apparent. The values of the centre panel parameters continued to rise at the end of 66 hours but at a decreasing rate.

Changes in compressive membrane forces in the centre panel and changes in beam tensions were slight.

9.2.5 Test to Failure of Floor as a Whole

9.2.5.1 General

This test was performed in two parts: the slab was first loaded to the predicted ultimate load of 775 psf applied after which the load was reduced to 400 psf. The load was then taken up again until failure of the centre panel at almost 850 psf. Failure of the centre panel was deemed to be the failure of the floor as a whole. At this stage the deflection of the centre panel increased markedly as tensile membrane action took over from compressive membrane action as the principal load carrying mechanism. Centre-edge panels were showing only moderate signs of distress at this stage and the corner panels even less.

9.2.5.2 Deflections

Maximum levels of deflection for the floor elements at the predicted ultimate load are shown in Table 9.4.

Most elements showed a sharp increase in deflection at 550 psf when the first cracking of the underside of the corner panels occurred, and a general loss of stiffness was evident after this stage.

The deflection of the centre panel increased steadily with load and was approximately equal to the depth of the slab when failure occurred and tensile membrane behaviour became predominant. The centre spans of all interior beams and the EW exterior beams tended to stiffen in the latter stages of the test, immediately prior to the failure of the

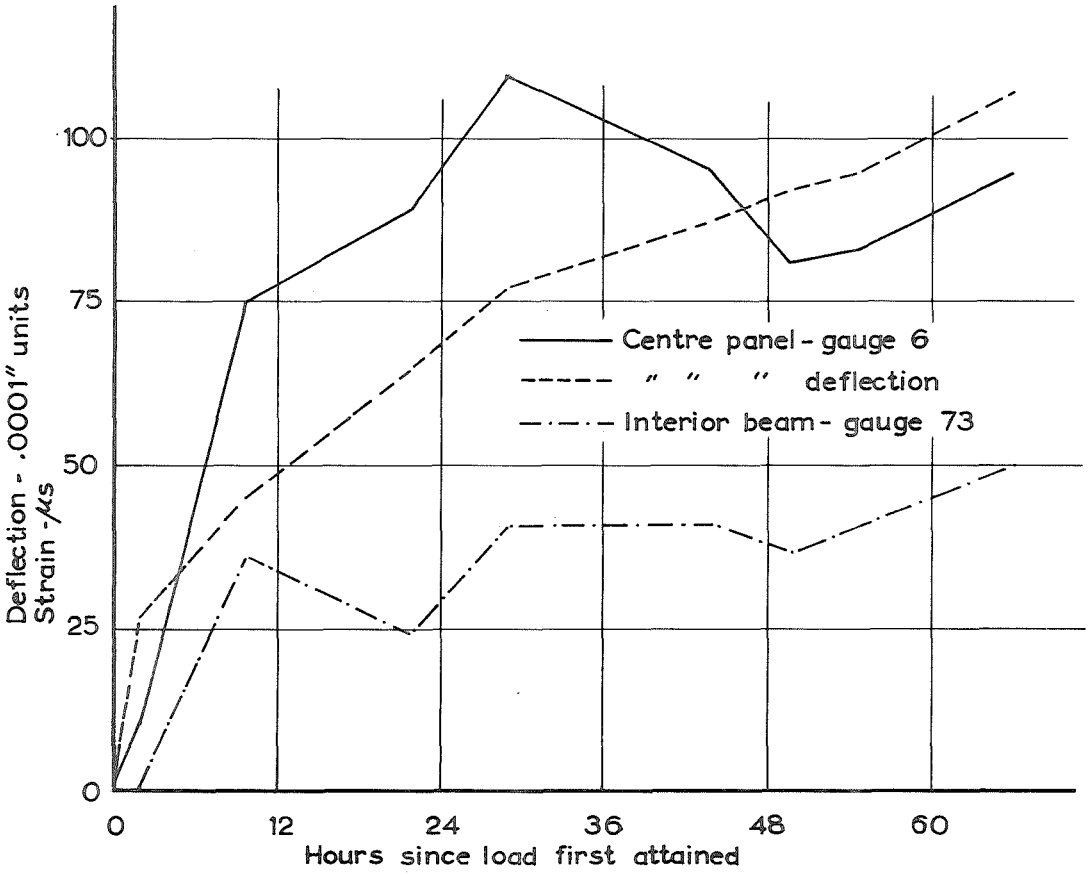


FIGURE 9.4 TIME EFFECT – LS189

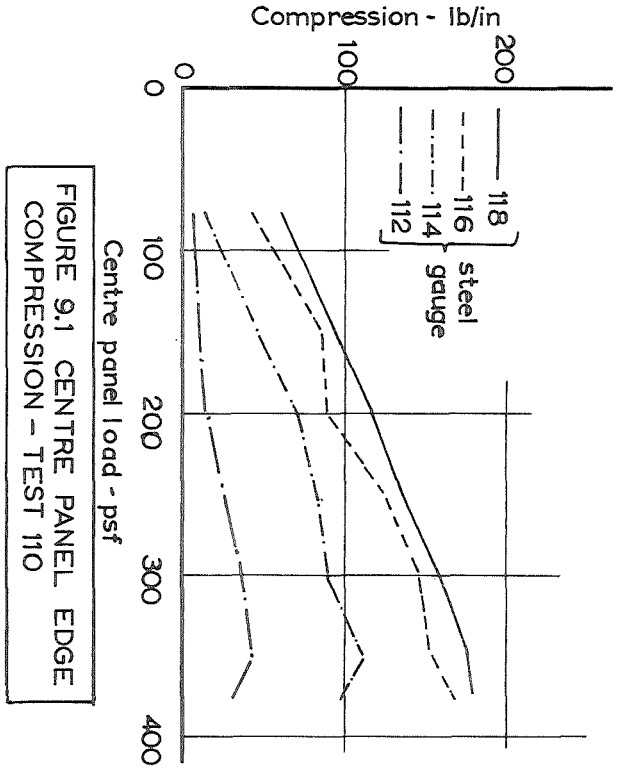


FIGURE 9.1 CENTRE PANEL EDGE COMPRESSION – TEST 110

centre panel.

Table 9.4. Deflections at LS220 (775 psf).

Element Type	Reference Mark (Figure 6.2(a))	Maximum Deflection (inches)	Deflection: Span (ratio)
Interior Beam	NS2	.143	438
Exterior Beam	NS4	.123	510
Corner Panel	A	.523	85
Centre-edge Panel	F	.649	68
Centre Panel	E	1.32	47
Interior Beam) East Span)	EW2	.430	104
Exterior Beam) East Span)	EW1	.135	330

9.2.5.3 Cracking

No fresh cracks appeared until a load of 500 psf was applied when a small number of cracks appeared in the beams. At 525 psf one further crack in the centre span of beam NS4 appeared.

The application of 550 psf (LS200, 200A, 200B) produced cracks in almost all elements with dramatic effect.

Further cracks appeared in the centre panel (Figure 9.5) and some centre-edge panels. Cracks appeared in all beam spans and first cracking of the undersurface of the corner panels occurred (Figure 9.7).

Again each new crack in any of the panels surrounding

the centre panel brought further cracking in the under-surface of the centre panel. The cracks in the corner panels were limited to one per panel running along the diagonal passing through the middle point of the centre panel giving the floor panel crack pattern an even more radial nature and further indicating the effect of compressive membrane action in the centre panel. The low reinforcement content of the panels meant that the cracking and ultimate loads of the corner panels were almost equal, and cracks formed rapidly and extended almost the whole distance from one corner to the other. In some cases the crack formation caused dull thuds.

Cracking in the beams at this stage was also significant. In the exterior beams cracks appeared over some interior supports and at the middle of some centre spans. In the end spans, cracks appeared very near the corner, (lower right of Figure 9.7) indicating the considerable bending moment induced by the twisting moment in the adjacent exterior beam at right angles. Similarly induced cracking took place in the end spans of interior beams (Figure 9.6 left middle; Figure 9.7). Cracks also appeared over the interior supports of these beams.

Although the crack widths in the panels and end spans of the beams shown in Figures 9.9, 9.10, 9.11 and 9.12 (taken at the end of the test programme) are very much greater than they were at failure of the centre panel,

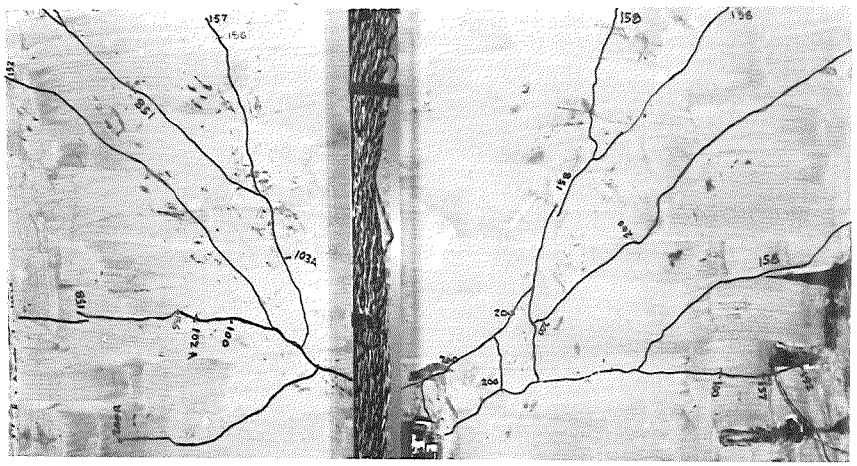


FIGURE 9.5 CENTRE PANEL

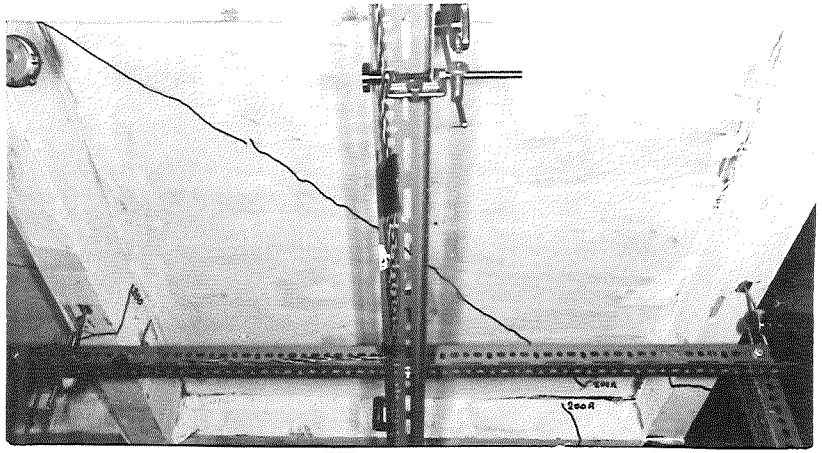


FIGURE 9.7 CORNER PANEL

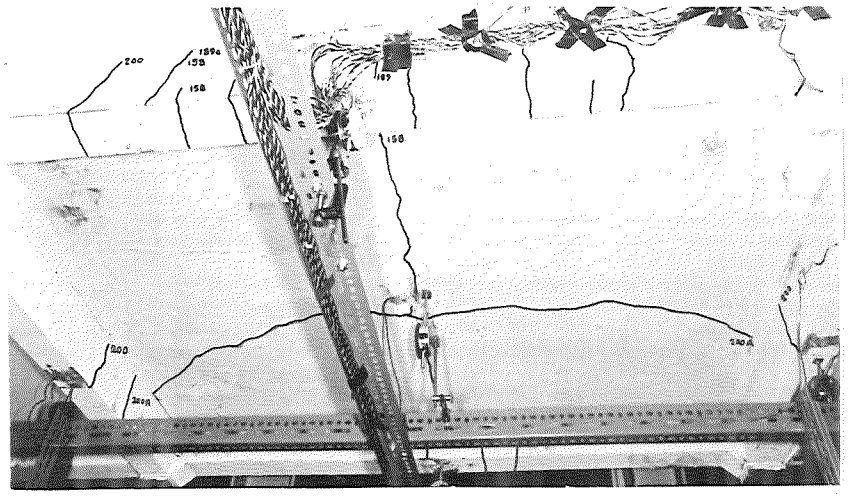


FIGURE 9.6 CENTRE-EDGE PANEL

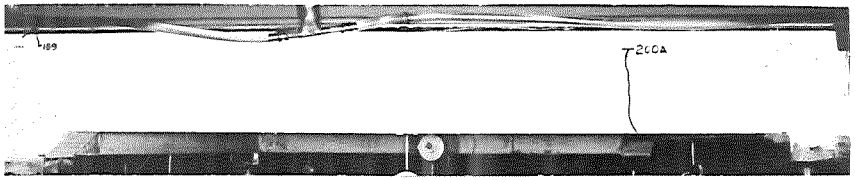


FIGURE 9.8 EXTERIOR BEAM, END SPAN

FIGURE 9.9 INTERIOR BEAM, CENTRE SPAN

FIGURES 9.5 to 9.9 CRACKING AT LS 200 (550 PSF)

the figures do show that much of the new cracking after LS200 (550 psf) was confined to the outer panels and end spans of beams (numbers lower than 228 indicate the extent of cracks formed before centre panel failure). The centre spans of interior beams showed few further cracks but the centre panel cracking extended considerably on the application of loads greater than 550 psf.

Load increase beyond 550 psf brought more cracks in the centre panel, radiating from the centre, extending further towards the edges of the panel as the tensile membrane region extended. These cracks became wider near the centre of the panel, becoming full depth before loading of the panel was stopped. The state of cracking in the centre panel after loading of it had been stopped may be seen in Figures 9.11 and 9.12. The zones of crushing on the top along the diagonals show the effects of the large "circumferential" compression. Full depth cracks extended further towards the edges of the panel in regions away from the diagonals.

9.2.5.4 Moment, Strain, and Normal Force Levels at Maximum Load

The wide load range of this test caused great changes in the levels of the above quantities and only a brief description of the changes occurring is given here. A detailed description follows in later sections (9.3.2, 9.3.5, 9.3.6).

Table 9.5 shows the values of strains, moments and normal forces for LS220 (775 psf) affording comparison with Table 9.3.

Almost all steel strains tabulated are either past yield or very close to it and the values of these at mid-span and support of the centre spans of both interior and exterior beams are nearly equal indicating little post-yield moment redistribution. Formation of cracks in the end spans did not coincide with the steel gauge position and some erratic strain values resulted.

In the centre panel, the strain in the steel at the centre increased to beyond the limit of the data logger. Steel strains at the edge were well in excess of yield as was the case for most points along the edges that were continuous over the beam supporting them. Values of steel strain at the panel edges supported by the exterior beams were remarkably low, especially in the corner panels.

Values of beam moments compared favourably with design moments at the supports but were lower than design values at mid-span. Tensions at the supports of the centre spans of both interior and exterior beams were larger than those at mid-span. The average magnitude compared well with design values but exterior beams carried a greater portion of the total than was expected.

9.2.5.5 Evidence of Membrane Action

The application of 550 psf at load stage 200 provided

Table 9.5. Strains, Moments, and Normal Forces at Load Stage 220.

	Gauge Position	Gauge Numbers	Max. Conc.St. μS	Max. Steel Strain μS	Moment K" or lb"/"	Force K or lb/"
Ext. Beam:						
C. Span	Support	133,134	-212	1256	30.2	10.6
C. Span	Mid-span	53,55	19	1584	13.1	7.3
E. Span	Mid-span	59,62	-11	1978	-3.4	1.7
Int. Beam:						
C. Span	Support	126,129	-572	1447	-92.0	15.3
C. Span	Mid-span	73,77	-209	1270	43.5	9.6
E. Span	Mid-span	64,67	-*	-*	9.3	3.6
Centre Panel:						
Centre	Bottom	6	-	*6979		
Edge		114,115	-187	8158*	-352	-149
Edge		118,119	-295	2428*	-509	-308
9" from edge		20,22	48	-71	-113	-197
Edge Panel H:						
Centre	Bottom	5	-	2306		
Edge	Int. Long	94,95	-222	2136	-405	-195
Edge	Ext. Long	97	-	193		
Edge	Short	102	-	4137		
Corner Panel:						
Edge	Int.	91	-	2723		
Edge	Ext.	86	-	103		

All strains corrected for drift (gauge 81) and 100 psf initial load.

Steel strains corrected for temperature (gauge 140).

Moments and forces calculated from strains shown.

* Values off scale or gauge broken.

clear evidence of the reliance of the centre panel on compressive membrane action. Later in the test, as failure of the centre panel approached, the level of beam tension and slab compression rose steadily but finally fell away rapidly with the push-through of the centre panel.

At LS200 cracking in the outer panels was radial in nature indicating the effect of membrane action in the centre panel. Again the effect of outer panel cracking was observed - the thuds produced by the cracking of the corner panels were coincident with sharp increases in centre panel deflection.

The three-quarters of an hour taken to settle at LS200 was a measure of the instability of the centre panel and a static situation prevailed only when all outer panels had ceased to crack.

Steeply inclined shear cracks in the interior beam centre span were indicative of the presence of considerable tension.

9.2.5.6 Failure Mechanism

The centre panel "failed" with the progression of the tensile membrane region towards the slab edges and panel edge compression decreased with consequent loss of beam tension. Centre spans of interior beams accordingly stiffened. Towards the outside edges of the centre panel a wide region of slab at high ("cirumferential") compression developed to support the tensile membrane area at the centre.

As the panel was pushed on into a more complete tensile membrane stage this region became narrower until crushing occurred.

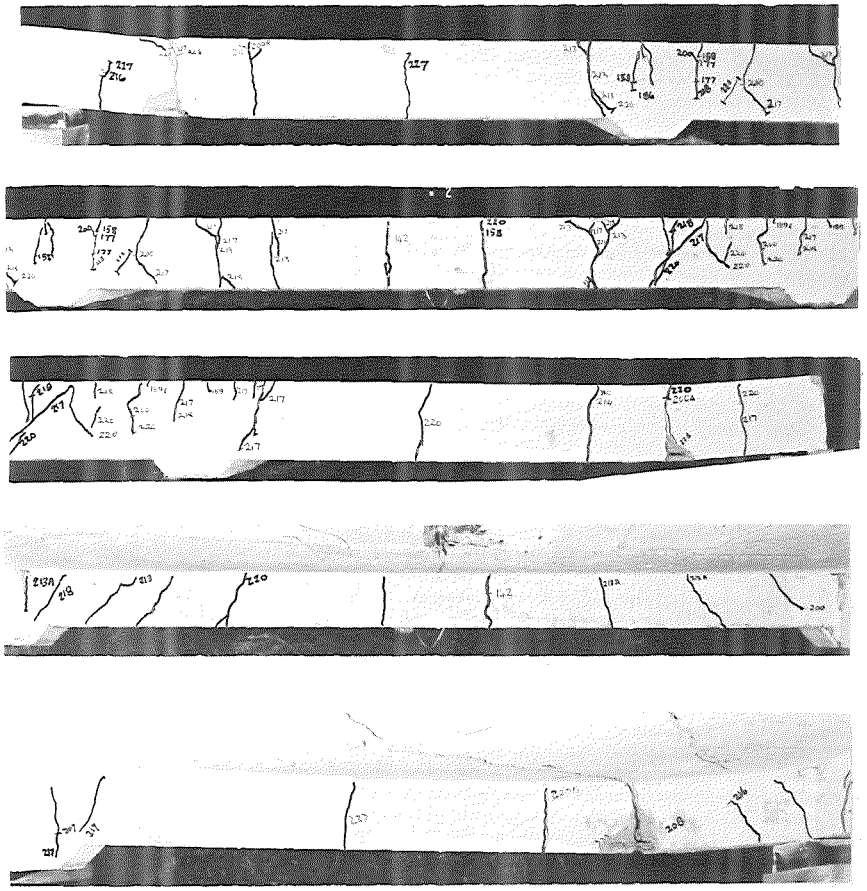
The centre-edge panels at this stage were in a fairly advanced stage of forming a composite panel and beam mechanism as can be seen in Figures 9.10, 9.11, 9.12. (The predominance of the beam mechanism evident in this illustration developed as a result of later loading.) Corner panels had cracked across both diagonals and were forming a panel mechanism, but again, later loading brought about the predominance of the beam failure mechanism.

Beams showed little sign of distress at this point. Centre spans of interior beams became increasingly stiff with the reduction in tension carried and the cracks in their end spans, which were later to develop into wide cracks at plastic hinges, were still narrow (see Figure 9.10).

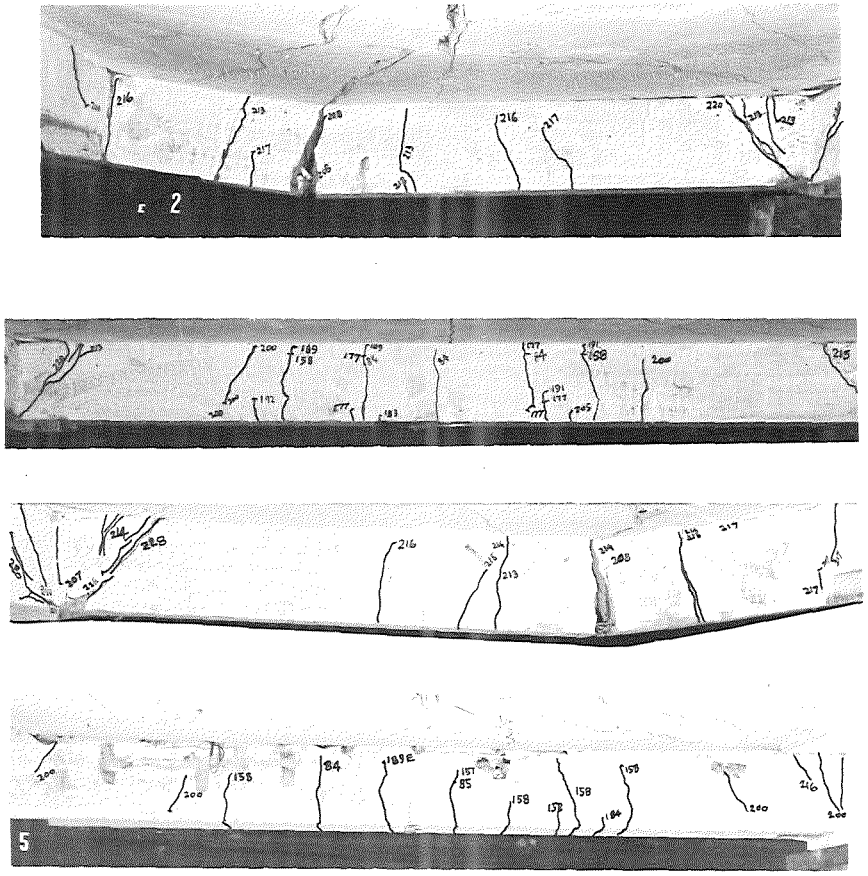
9.2.6 Test to Failure of Outer Panels

In this test the centre panel load was kept constant at 600 psf while the outer panel load was increased until the centre-edge panels "failed" at 966 psf. Corner panel load was then increased with centre panel load still 600 psf and centre-edge panel load 950 psf. Failure of the corner panels occurred at 1170 psf.

Only a general description of the floor behaviour and failure modes is given. Many steel gauges had gone off the



Exterior beam EW1



Interior beam EW2

FIGURE 9.10 BEAMS AT END OF TEST

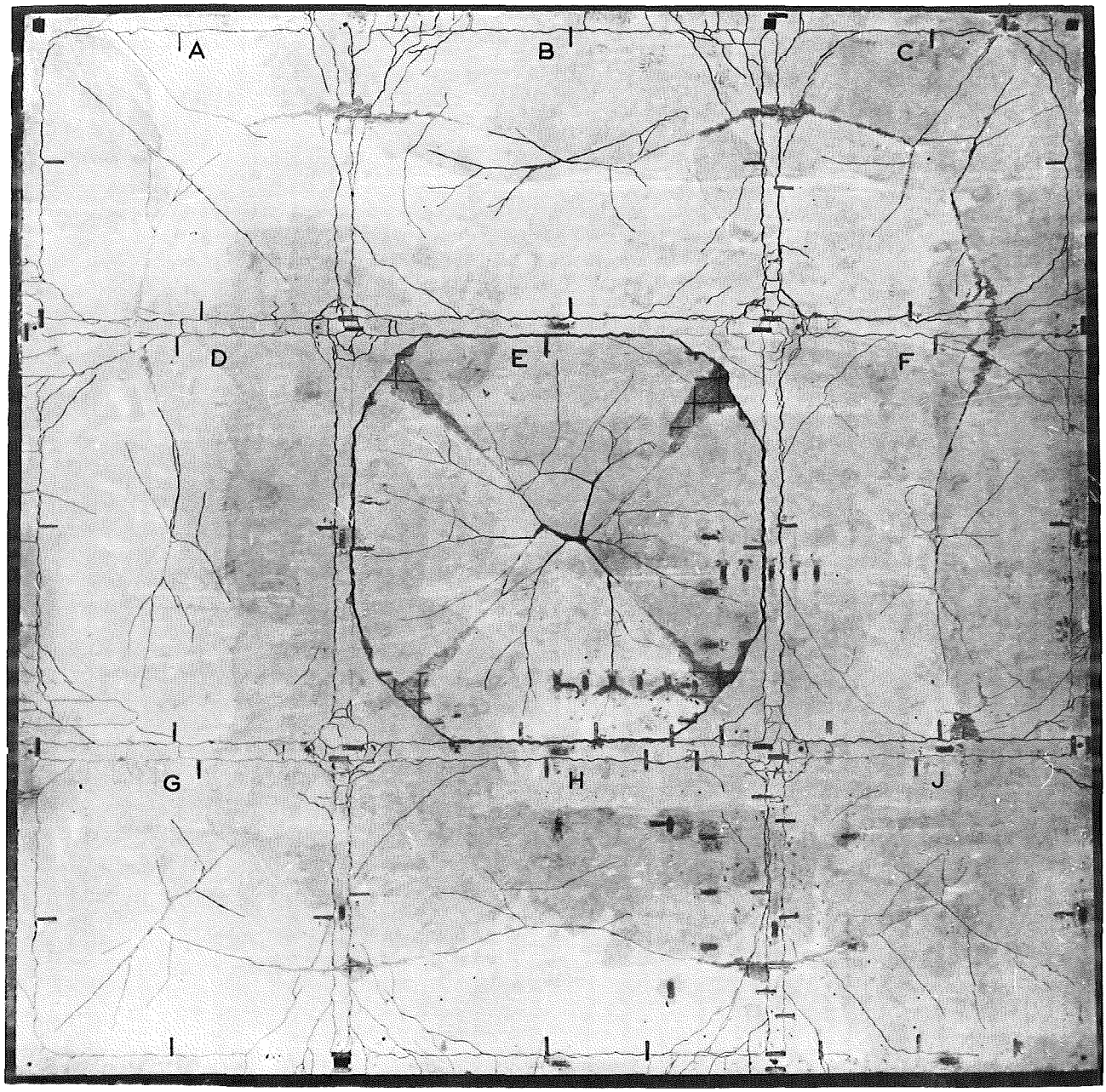


FIGURE 9.11 LOADED SURFACE AT END OF TEST

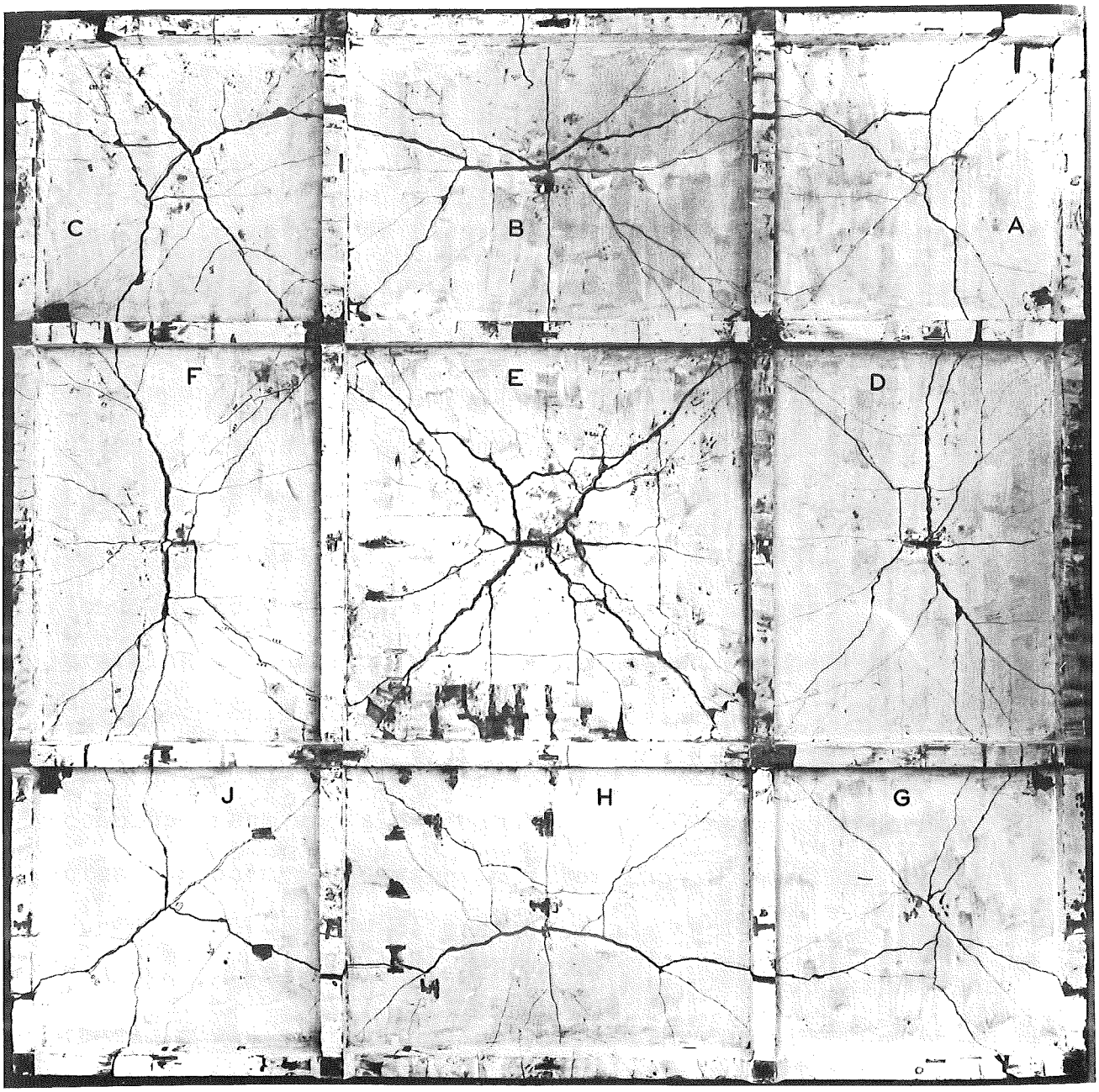


FIGURE 9.12 UNLOADED SURFACE AT END OF TEST

data logger scale and cracks had rendered many concrete gauges useless.

Figures 9.10, 9.11, and 9.12 show the final state of the floor.

The formation of plastic hinges in the positive moment regions of the end spans of the interior beams brought about a pronounced folding mechanism in the centre-edge panels and affected the corner panels similarly at a later stage. The centre edge panels showed no sudden drop in load capacity but at 966 psf on all outer panels, the rate of deflection under constant load was so great that the load on these panels was not increased further. Full depth cracking at the middle of the centre-edge panels had only just developed at this stage, the principal cause of the loss of load capacity being the full development of the combined beam and slab mechanism, evident when concrete crushing occurred at the interior supports and on the top surface above the wide cracks in the end spans.

The load on the corner panels was taken up until these panels could sustain no further load. Again, beam mechanisms were responsible for this inability to sustain further load. Concrete crushing at the supports of the interior beams continued and large rotation of plastic hinges in the end spans caused considerable twisting of the exterior beams and the development of the combined torsional and flexural hinges near the corners resulted (see Figures 9.10, 9.11

and 9.12).

The test was stopped at 1170 psf when the deformation rate was excessive.

An interesting feature of this test was the lack of development of yield moments along the slab edges supported by the exterior beams.

The following steel strains indicate the degree to which yield moments were developed along these edges. Readings were taken at LS239.

Position	Gauge No.	Microstrain
Corner panel:		
Interior edge	83	1870
	91	4440
	84	2130
	90	2000
	85	2300
Exterior edge	86	240
	88	2200
	87	220
	89	970
Centre edge panels:		
Interior edge (short)	98	2970
	99	3100
	100	2040
	102	8000+
Exterior edge	96	1860
	97	2220

At the end of the test the principal crack in each centre-edge panel was that along an arc between cracks in

the end spans of the interior beams supporting the panel (see Figure 9.12). This crack was full depth for the middle 24" but T-beam flange effects caused closure at the top of this crack in the region of the beams (see Figure 9.11).

Cracks along the exterior edges of the corner panels were measured at .002" at the end of the test programme.

Development of flexural hinges in the end spans of interior beams allowed large torsional rotation of the exterior beams and torsional resistance was provided only by the end spans of the exterior beams. Each such span showed the effect of this with the development of a torsional and flexural hinge, to a greater degree in some beams than others. Figure 9.10 (c) shows the most fully developed of these at the end of the test programme.

9.3 EXAMINATION OF ASPECTS OF FLOOR BEHAVIOUR DURING TESTING

9.3.1 Deflections

Figures 9.13 and 9.14 show load-deflection plots for the full range of load applied over the whole top surface. Each curve is typical of its group and the values plotted include residual deflections. The difference between NS and EW exterior beams is apparent when the curves for the east and south exterior beams are compared.

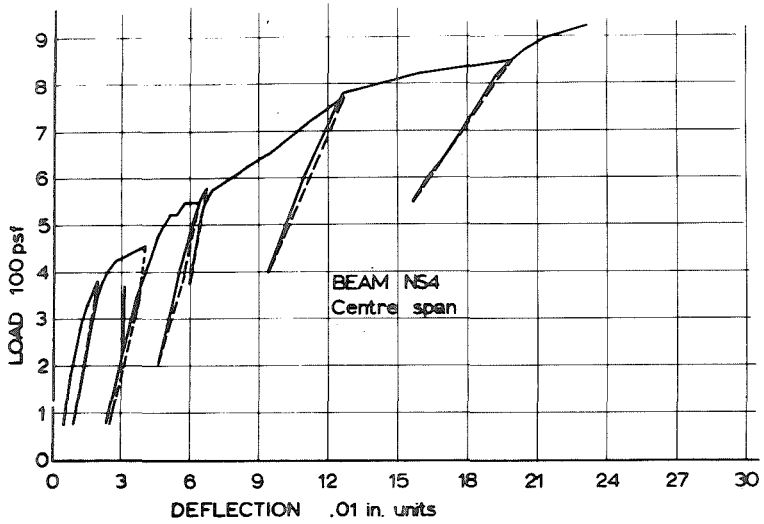
The curves for the centre, corner, and centre-edge panels all show the effects of cracking at 550 psf but at

450 psf, only the centre-edge and centre panel deflections show a marked increase.

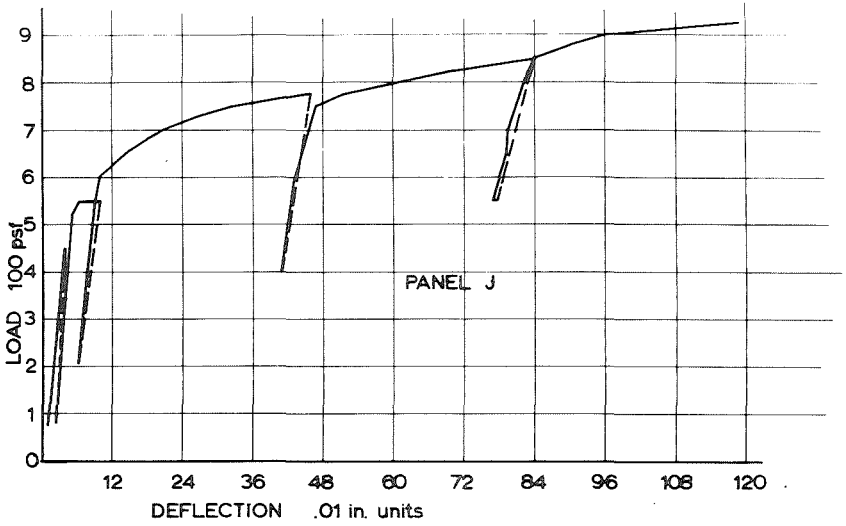
Loss of stiffness of all panels after 550 psf is clearly seen and the similarity of shape of the corner and centre-edge curves after this stage show the effects of supporting beam deflection. The centre panel load-deflection curve indicates the push-through failure that occurred at a deflection of nearly 2". Because 850 psf was not fully attained the path of the load-deflection curve for the centre panel was not accurately determined. The load-deflection plot for the tensile membrane stage is close to a straight line through the origin.

The curious shape of the curves for the centre spans of interior and exterior beams is due to the effect of tension in these spans. The loss of tension in the beams towards the end of the test is evident in the steepening of these curves, especially in the interior beams in which deflection decreased with increase in load near the end of the test. However, this was due in part to the formation of plastic hinges in the end spans of these beams.

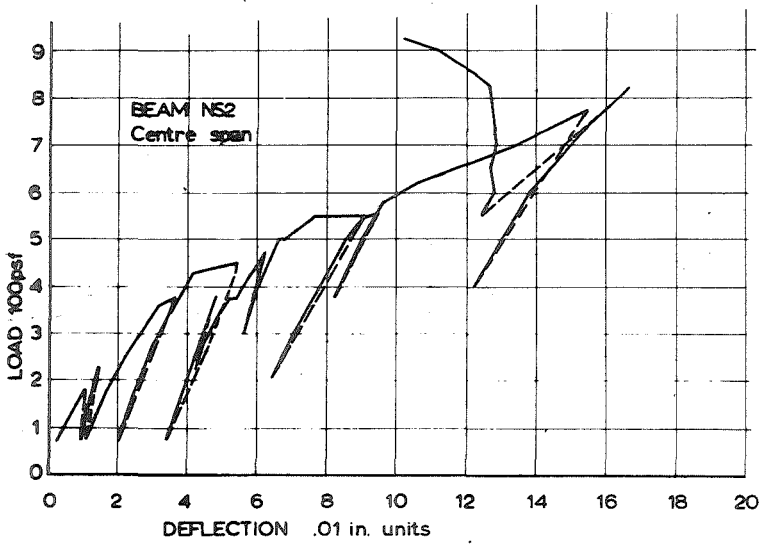
The varying scale used in Figures 9.13 and 9.14 makes comparison of stiffnesses difficult. Figures 9.15 and 9.16 show load-deflection plots for Tests 106 and 110 in which deflection at the start of Test 110 has been set equal to that at the end of Test 106 and the constant horizontal scale makes direct comparison of relative stiffnesses



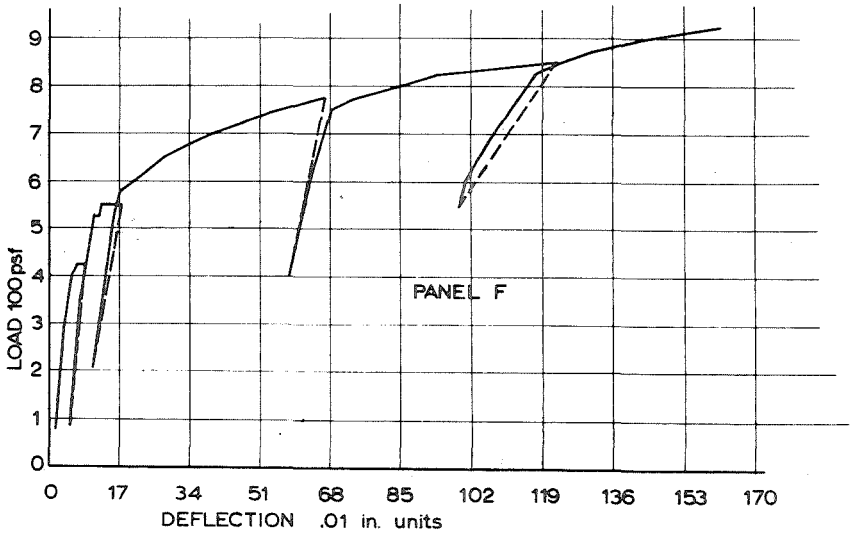
(a)



(b)

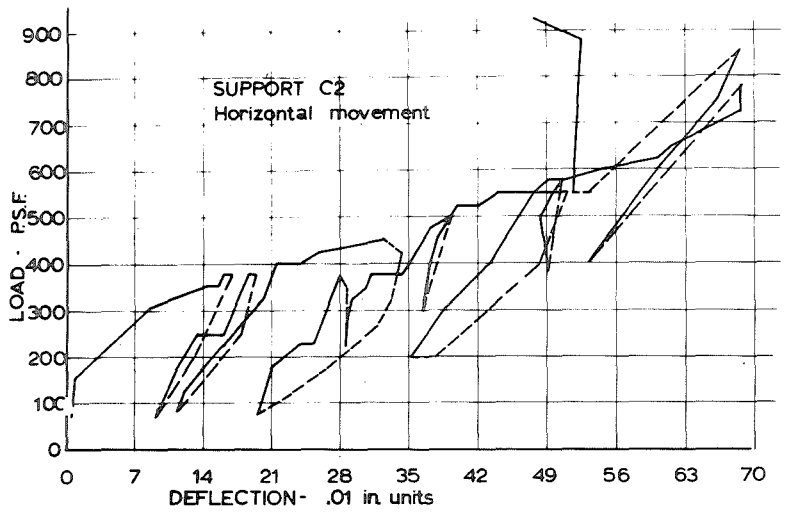


(c)

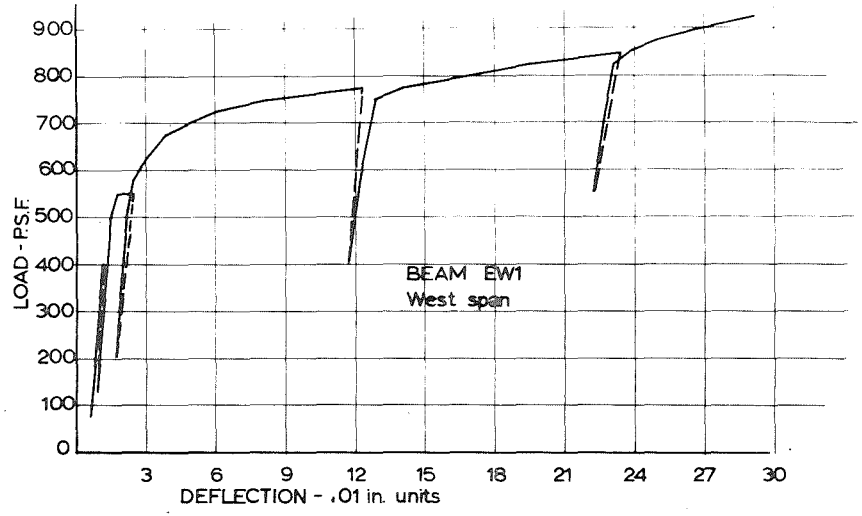


(d)

FIGURE 9·13



(a)



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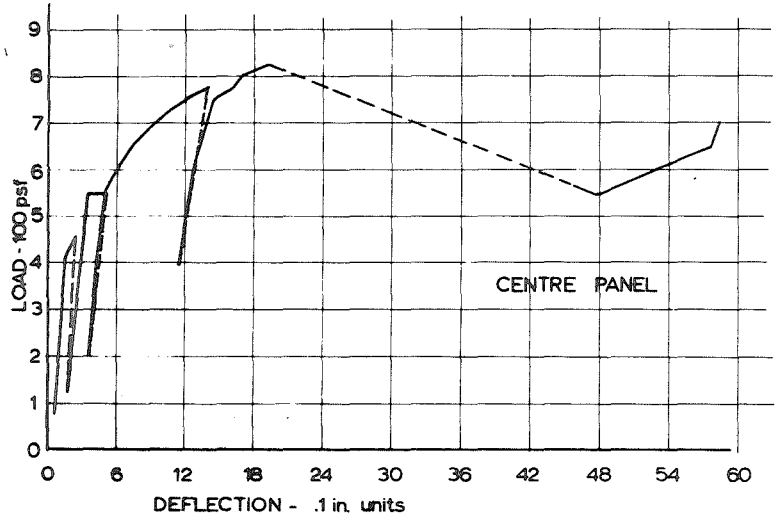
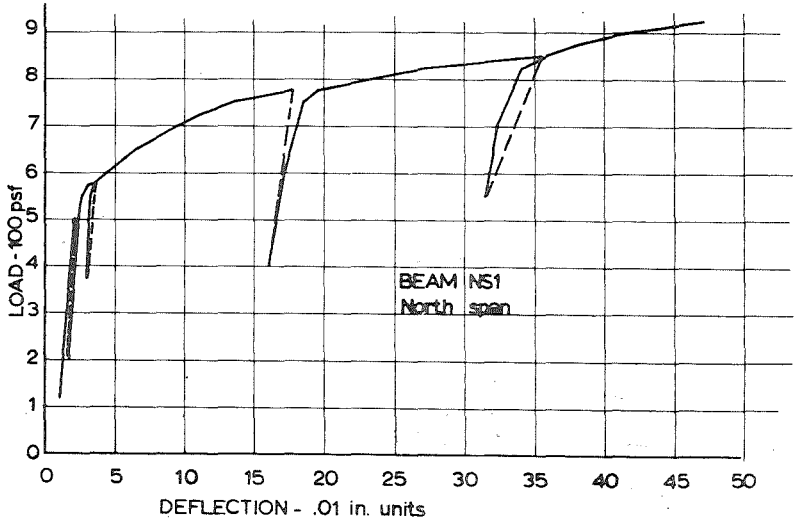


(c)



(d)

FIGURE 9.14

possible.

Table 9.6 gives the deflection readings for all gauge points. In some cases, pattern loading caused upward deflections (negative values) and the sharp increases in deflection at LS158 and LS200 are noticeable, especially in panels and centre spans of beams.

It is of interest to compare the deflections in the table with ACI code requirements for deflections. ACI-318-63 Clause 209 specifies 1/360 of the span as the maximum allowable for floors carrying plaster ceilings, 1/180 of the clear span otherwise. The most stringent requirement for long term loading is the allowance of an additional deflection of twice the short-term deflection.

The first values which exceed the L/360 requirement are marked with an asterisk in Table 9.6. When the first values of deflections at design service load are factored by 3.0 to allow for long term deflections, the centre panel just exceeds the L/360 requirement.

However, the dependence of the centre panel on compressive membrane action makes the assessment of long term deflections a special case in which the deflection is unusually sensitive to outward creep of surrounding elements which provide the necessary lateral restraint. At service load, however, the magnitude of the membrane forces may not be high and it is reasonable to conclude that the deflections of the floor at service load would not be

TABLE 9.6 DEFLECTIONS AT SELECTED LOAD STAGES FOR ALL GAUGE POINTS (.0001 INCH UNITS)

LOAD STAGE	32	57	7A	85	104	123A	142	142C	155	15[illegible]	177	189	194	213	217	220	226
MAX LOAD	225	225	225	375	375	400	375	375	375	450	375	375	500	600	700	775	825
PATTERN	2	3	1	1	5	2	3	3	1	1	5	1	1	1	1	1	1
GAUGE NO.																	
1	39	-16	23	64	25	107	25	15	64	85	46	73	99	234	512	900	1435*
2	48	-19	25	57	7	97	20	0	68	81	43	85	110	268	450	1000	1560*
3	37	-8	28	58	18	107	21	9	59	77	52	69	90	134	212	527	877
4	41	-6	33	76	15	116	26	8	71	90	57	86	109	345	623	1346*	2136
5	42	-12	30	69	20	110	25	10	51	80	56	80	98	212	410	1160	1900*
6	41	-9	24	55	21	101	21	6	53	71	56	72	91	141	436	591	881
7	42	-18	30	79	30	102	36	25	77	98	65	90	110	195	425	950	1630*
8	34	-17	29	59	2	94	-6	-21	39	49	22	46	70	129	391	559	1029
9	29	21	40	136	61	101	112	111	124	175	123	155	213	362	719	1591*	2397
10	27	28	53	144	47	104	119	115	143	190	130	176	231	475	1188	2302*	2943
11	17	21	39	118	37	87	103	97	106	147	103	147	191	492	1642*	4307	6447
12	20	21	40	121	55	93	111	108	116	161	150	221	256	478	801	1811*	2731
13	22	26	41	111	43	90	99	93	71	68	54	131	163	391	881	1701*	2661
14	24	24	45	120	32	84	95	93	115	155	106	152	198	495	944	1795*	2645
15	25	25	43	122	37	87	101	95	122	154	106	151	194	379	757	1462*	2232
16	11	21	32	111	31	86	87	80	103	141	93	141	191	318	691	1571*	2461
17	32	40	75	262	230	220	250	240	310	550	470	510	650	963	1234	1342	1452
18	40	45	85	285	266	273	285	257	315	409	465	445	555	861	1135	1186	1245
19	25	30	60	261	227	210	240	231	290	540	445	490	612	902	1090	1147	1220
20	40	35	80	253	210	205	225	225	274	435	365	405	555	901	1235	1425	1555
21	-35	70	40	110	15	-37	141	162	121	320	240	300	371	491	580	562	425
22	-30	73	50	140	30	-18	170	200	165	340	260	345	435	738	1007	1228	1540
23	-33	65	40	110	34	-22	164	223	184	367	293	176	464	587	685	590	440
24	-21	84	61	154	-39	-1	189	218	179	399	309	384	479	761	969	1139	1204
25	100	-5	85	205	40	250	115	85	215	305	197	293	400	886	1975*	4500	6880
26	100	-5	90	210	48	268	120	89	210	291	193	296	400	1230	2405*	4342	8130
27	100	5	82	185	42	239	101	75	190	282	195	282	383	1242*	2770	5230	7650
28	92	-1	79	184	31	229	94	69	189	279	179	269	372	785	2074*	4279	6579
29	20	122	122	365	105	90	400	417	430	732	535	700	920	2050*	3855	6490	9230
30	-10	133	122	335	121	96	402	415	330	672	440	648	840	1924*	3390	6330	8882
31	5	145	138	345	97	75	367	390	385	727	546	705	924	1802*	3385	5428	7537
32	75	135	135	403	114	95	378	385	391	725	543	694	907	1287*	3054	5655	7775
33	211	-6	214	616	871	921	596	524	976	2166*	2137	2139	2746	5586	8931	13167	18739

* First value in excess of L/360
L/360 = 1240 units for short spans
L/360 = 1730 units for long spans.

FIGURE 9.15 DEFLECTIONS – TESTS 106, 110

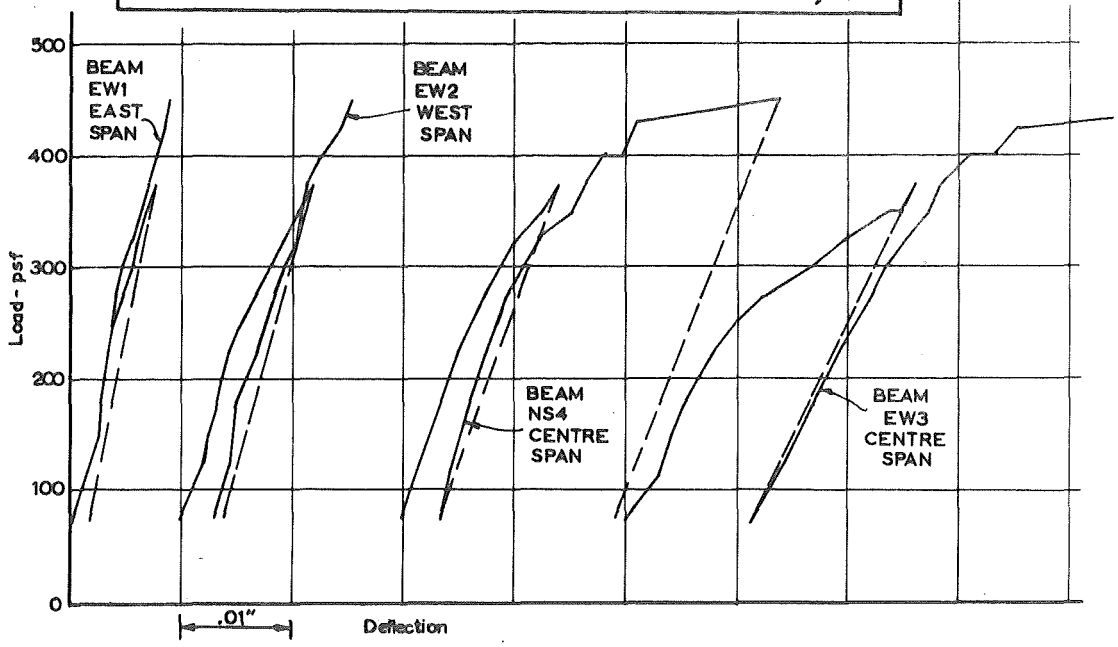
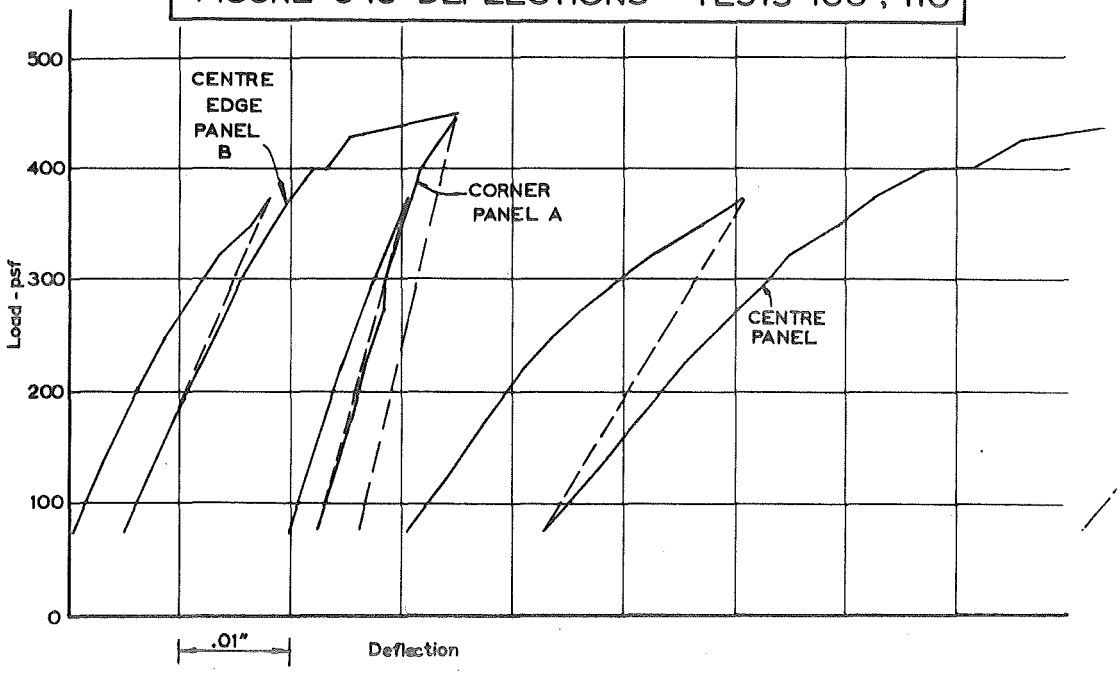


FIGURE 9.16 DEFLECTIONS – TESTS 106 , 110



excessive in the long term.

9.3.2 Strains

9.3.2.1 General

Readings in microstrain at selected gauge positions are presented in Table 9.7. Load-strain curves for the latter part of the test programme appear in Figures 9.17 to 9.21. Appendix C contains readings for all channels at all load stages.

9.3.2.2 Strain Levels

Table 9.7 shows the generally low level of strain at 375 psf applied at LS85, no underside panel cracking having taken place at this stage, but the shrinkage cracks present before testing commenced, show up in the higher strain values at the panel edge sections. Cracking of the underside of the centre panel at LS100 (as the outer panel load was reduced) brought a sharp increase in strain in the centre panel bottom steel (e.g. gauge 6) with little effect on the strains at the edge of the panel.

Strain values were still comparatively low at LS155, gauge 5 recording the highest level at less than half the yield strain. The effect on the strain levels of the application of 450 psf is seen most clearly in Figures 9.18 to 9.21 inclusive. Centre-edge and centre panel strains showed a particularly large rise with the occurrence of underside cracking in these panels, yield being reached in

TABLE 9.7 STRAINS AT SELECTED POINTS

GAUGE No.	YIELD STRAIN	LSN LOAD	32 225/2	57 225/3	7A 225/1	85 375/1	104 375/5	123A 400/2	142B 375/3	155 375/1	158 450/1	175 350/5	189 375/1	193 475/1	200 550/1	213 600/1	218 725/1	220 775/1	226 825/1
57	1340		49	-9	23	45	-5	84	-19	33	47	7	38	77	83	134	1566	2135	2159
52	1340		11	95	71	112	18	-27	117	107	548	478	529	641	996	1145	1362	1478	1685
63	1340		73	65	83	125	26	97	97	132	161	96	136	193	985	1636	2098	4713	6629
73	1340		125	101	160	323	299	279	265	331	596	497	549	680	794	982	1271	1270	1297
124	1430		44	49	63	111	87	110	135	168	373	330	377	443	496	804	1206	1358	1630
136	1430		43	54	65	135	87	104	175	216	439	379	452	543	618	846	1206	1462	1916
96	1690		-6	9	-3	9	-39	-64	-52	-54	-35	-83	-71	-27	-27	20	599	840	1046
98	1690		55	88	97	260	126	165	306	390	633	542	659	813	890	1133	1786	1922	2000
88	1690		13	6	7	18	-12	2	-17	-6	2	-35	-19	13	11	21	35	91	128
91	1690		89	83	118	233	128	216	242	383	870	779	919	1079	1196	1513	2623	2723	2655
111	1690		113	85	139	221	246	278	237	361	1272	1063	1223	1528	1764	1921	1945	1976	1600
6	1690		68	29	56	177	625	683	494	671	1650	1540	1638	1909	2264	-	-	-	-

All values corrected for temperature and drift.

Refer to figures 7.2 and 7.3 for gauge positions.

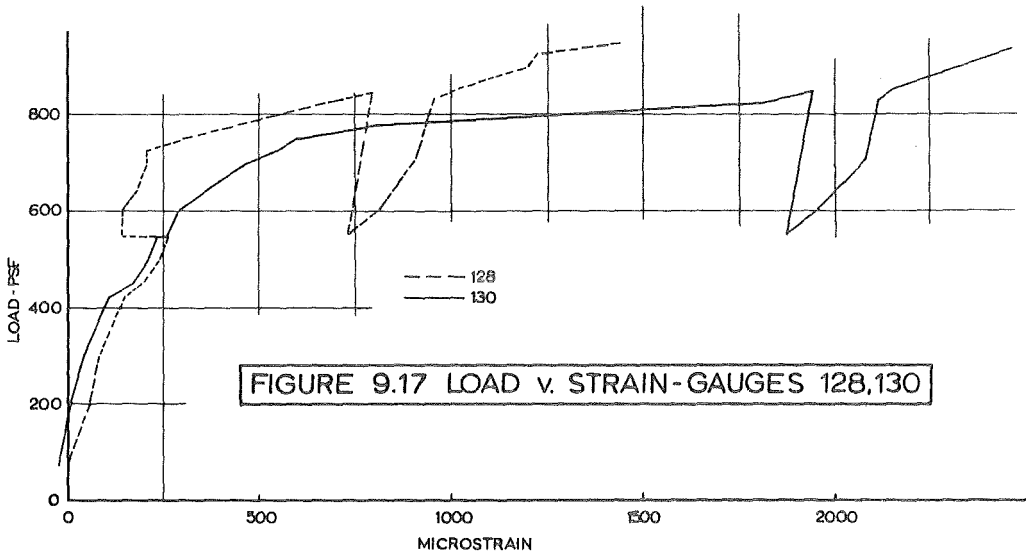


FIGURE 9.17 LOAD v. STRAIN - GAUGES 128,130

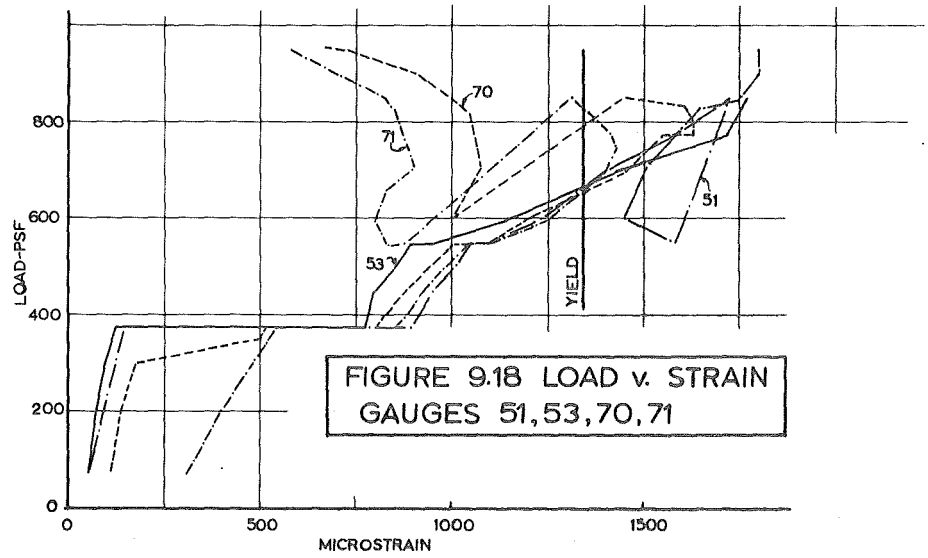


FIGURE 9.18 LOAD v. STRAIN GAUGES 51, 53, 70, 71

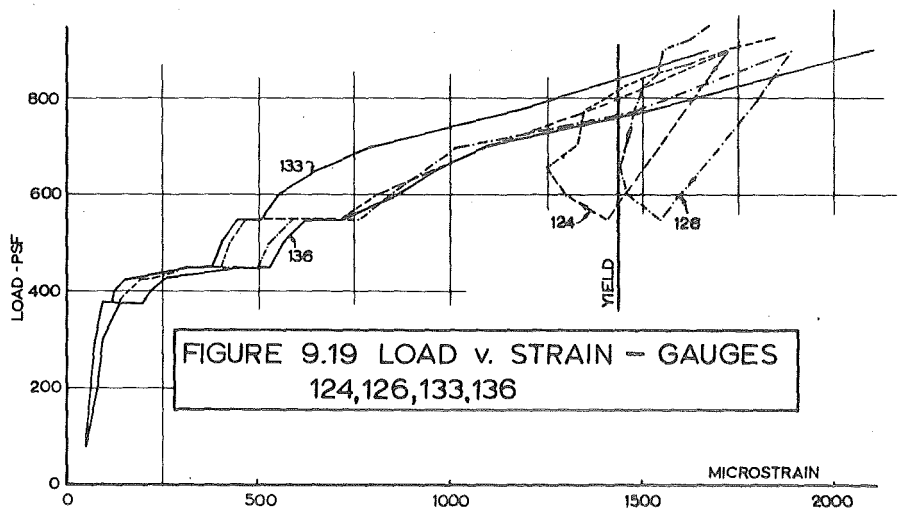


FIGURE 9.19 LOAD v. STRAIN – GAUGES 124,126,133,136

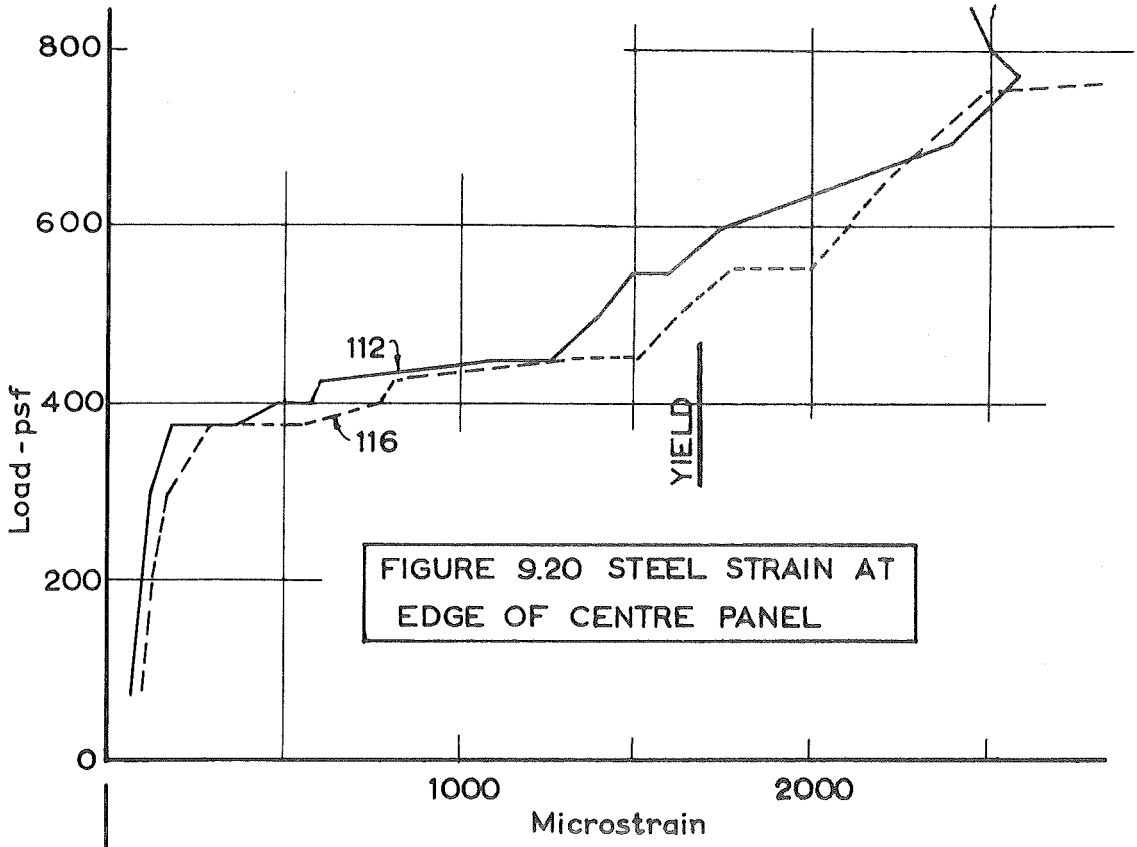


FIGURE 9.20 STEEL STRAIN AT EDGE OF CENTRE PANEL

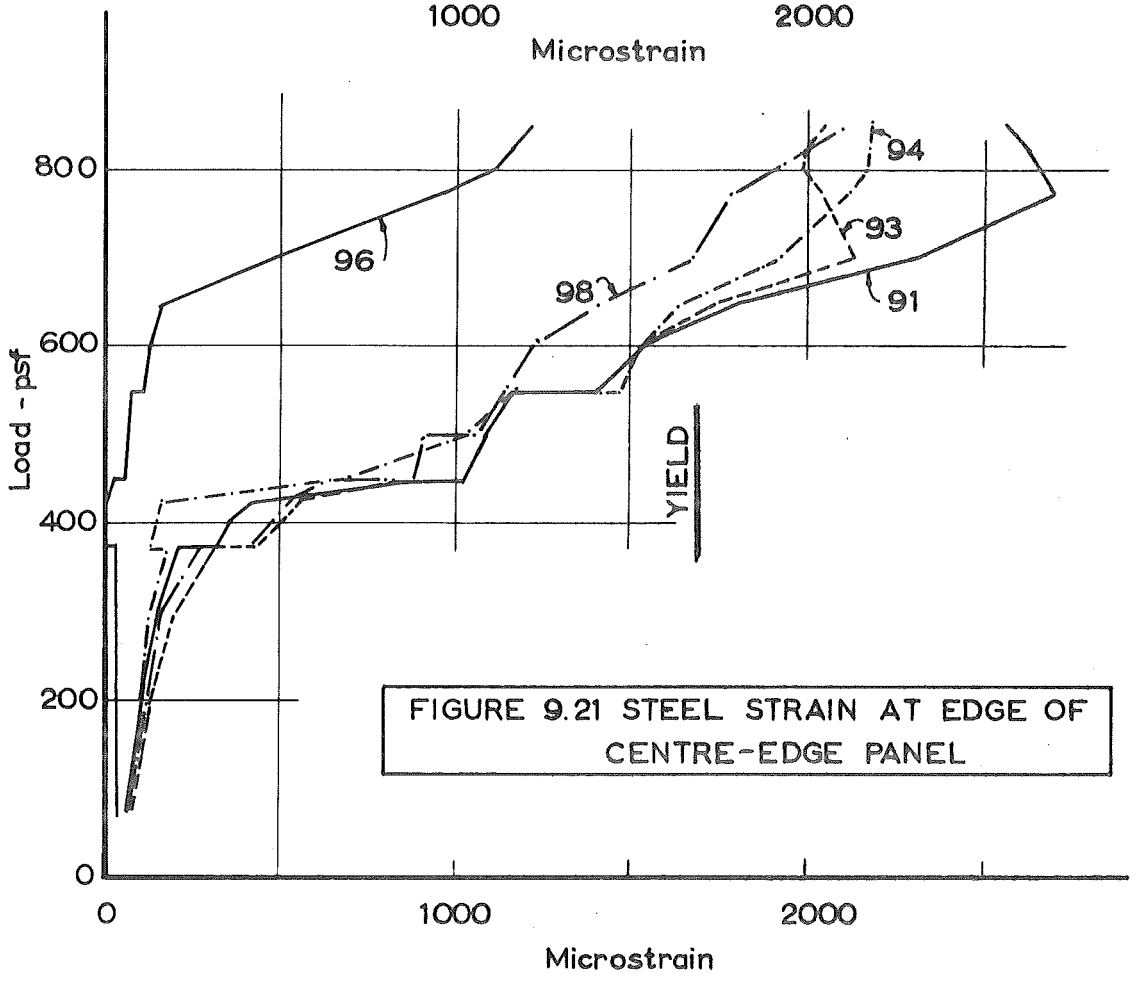


FIGURE 9.21 STEEL STRAIN AT EDGE OF CENTRE-EDGE PANEL

the bottom steel at the middle of the centre panel.

Levels of strain continued to rise with load but not always at the expected rate, a feature particularly noticeable at the edges of the centre panel. The slower increase at the edges of the panels (see Figure 9.20) coupled with the steady increase in beam steel strain indicate quite clearly the effect of membrane action.

A slow rate of steel strain development in the edges of the centre-edge and corner panels was also evident. In the centre-edge panel, steel strain development along the short edges lagged that along the interior long edge but yield was reached before 775 psf was applied to the whole floor. At this stage, however, gauge 96, on the exterior long edge showed only 990 μS and it was only during the test to failure of this panel that the steel along this edge yielded.

Along the outer edges of the corner panels steel strains were small throughout and even in the later test to failure of these panels these strains never became large.

The reason for this low value of strain at the edges was clearly a result of the smaller edge restraint afforded by the edge beams, retarding the development of moment. Although the edge beams were sufficiently strong to carry the torsion induced by the full yield moment, the rotation required to achieve this was too great and compressive

membrane action developed in the panels to compensate for the slow development of the full yield value. In the corner panels the beam mechanism formed completely before the panel mechanism was fully developed and so the yield value was never reached at the edge.

Figure 9.19 shows the strains at the supports of the centre spans of both interior and exterior beams while Figure 9.18 shows the steel strains at mid-span of both beams. The similarity between exterior and interior beams is good, and after cracking, the separate curves of load versus strain have nearly identical shape for both mid-span and support.

Beam steel strains at 775 psf are seen to be in the vicinity of yield. This has two important implications. The closeness of both mid-span and support values to yield indicates that little moment redistribution was required and secondly, the fact that yield of this steel was accomplished is indicative of large beam tensions of the order expected.

Steel strains in the interior beams show a tendency to reduce with increasing load beyond about 750 psf, a clear indication that the maximum tension had been reached and was reducing. This effect was more marked at mid-span than at the support where steel was required to take the moment due to the load on the end spans.

Generally the concrete strains were of little value as

a means of determining the maximum strains in the concrete. This was particularly noticeable for the panel edge sections where the region of high concrete strain was confined to about one eighth of an inch width at the beam-slab junction. The gauge was not therefore in the correct position to measure the maximum strain. Even if the gauges had been correctly positioned the small area over which high strains took place would have led to reduced readings since the gauge reading would be an average over the 1 inch gauge length. These factors did not render the readings useless for the purposes of computing membrane forces as is discussed in Section 7.3.4.

Beam concrete strains were less sensitive to this effect and Figure 9.17 shows the strains as measured by gauges 130 and 128 followed through increasing load. The curve for gauge 130 has a continuous form and the two curves are almost identical up to 550 psf, the small increase at 450 psf showing up in both curves. At 550 psf when the corner panel cracked on the underside for the first time and the centre-edge panels cracked further, the curves part, the strain in gauge 128 dropping significantly in magnitude. This drop, with the slower increase that followed it give a clear indication of the presence of tension in the beams.

9.3.3 Cracking

9.3.3.1 General

Development of crack patterns in the elements of the

floor during testing has been described fully in the preceding sections on test by test behaviour of the floor (see Sections 9.2.4.3, 9.2.5.3, 9.2.6). This section is devoted to the examination of the serviceability of the floor at design service load with respect to crack widths.

9.3.3.2 Crack Width Serviceability

Only at Load Stage 161 were widths measured in detail. These are shown in Figure 9.3 (p. 185). Although the measurements were taken at an applied load of 375 psf (DL + LL), the maximum load sustained up to that stage was 450 psf. This overload had little effect on the beams and centre-edge panels, but the cracking in the centre panel that took place at 450 psf was considerable and crack widths were substantially larger than the first DL + LL values.

The values shown in Figure 9.3 are maximum values and as such may not be compared directly with the quoted limits of ACI 318-63 Clause 1508 which gives .015" as the maximum mean crack width for interior members, .010" for exterior members.

In this comparison, the effect of scale and of the relation between maximum mean crack widths and maximum crack widths was accounted for by adjusting the code values. Average crack widths are generally taken as two-thirds of the maximum values and the ACI code values were therefore increased by 50 per cent for comparison with maximum

prototype crack widths.

Allowance for scale was made in two ways: (i) on the assumption that crack width varies as the square root of the scale factor and (ii) on the assumption that crack width varies directly with the scale factor.

The maximum allowable model crack widths resulting from the above adjustments are summarised in Table 9.8.

Table 9.8. Maximum Allowable Crack Widths For the $\frac{1}{4}$ Scale Model Floor.

Exposure Condition	Maximum Allowable Crack Widths (inches)						Max. Observed Crack Width Figure 9.3
	1	2	3	3A	4	4A	
Interior	.015	.022	.005	.013	.011	.028	.015
Exterior	.010	.015	.004	.010	.007	.018	.015

The numbers 1-4 in the table refer to the difference adjustments, as follows:

1. Normal ACI 318-63 Code values for maximum allowable mean crack width.
2. Values in 1. increased by 50 per cent for comparison with absolute maximum crack widths on prototype.
3. Values of 2. adjusted for scale variation directly proportional to the scale factor.
4. Values of 2. adjusted for scale variation proportional to the square root of the scale.

Columns 3A and 4A require further explanation. The crack widths in Figure 9.3 were measured at the design service load but only after the overload to 450 psf had produced a marked effect on the centre panel cracking. Values of columns 3 and 4 were factored by the ratio of steel strain in the bottom steel of the centre panel for design service load, before and after the application of overload. This was found to be approximately 1:2.5. Since crack width is proportional to steel stress, the relationship between the values of columns 3A or 4A and those of Figure 9.3 may be assumed to be the same as the relationship between centre panel crack widths before overload, and the actual maximum allowable crack widths for the model.

Comparison of values of Table 9.8 with those of Figure 9.3 reveals that for an assumed variation proportional to the square root of the scale factor, all beams and outer panels satisfy the more stringent limit of .007". Centre panel crack widths do not satisfy either exposure condition but when adjustment is made according to the ratio of steel stresses, all centre panel crack widths are seen to be less than the more stringent exterior exposure condition for maximum allowable crack widths.

It was concluded that if crack widths were assumed to vary as the square root of the scale factor, the serviceability of the model floor with respect to crack widths was

more than adequate for loads not in excess of the design service load. Two qualifications must accompany this conclusion, viz:

(i) Exposure to exterior conditions would result in marginal serviceability if crack widths varied directly as the scale factor.

(ii) The dependence of the centre panel on compressive membrane action to improve its load carrying capacity and serviceability.

9.3.4 Reactions

9.3.4.1 General

Measured reactions came close to expected values throughout most of the test programme. The prime use for these was in the calculation of moments across full width sections of the floor (see next section). In this section, the variation of reaction with load is discussed briefly and a comparison with expected values is made.

9.3.4.2 Variation of Reaction with Applied Load

Figure 9.22 shows plots of reaction value against load for support points C3, A2, and D1 respectively. The scale for reaction value was chosen to make direct comparison of the three figures possible. The reaction ratio plotted is the value of the reaction measured, divided by the expected value of reaction at the point for a load of 775 psf applied over the effective loaded area of the floor surface. The true origin for the graph is at -33 psf (= dead weight/

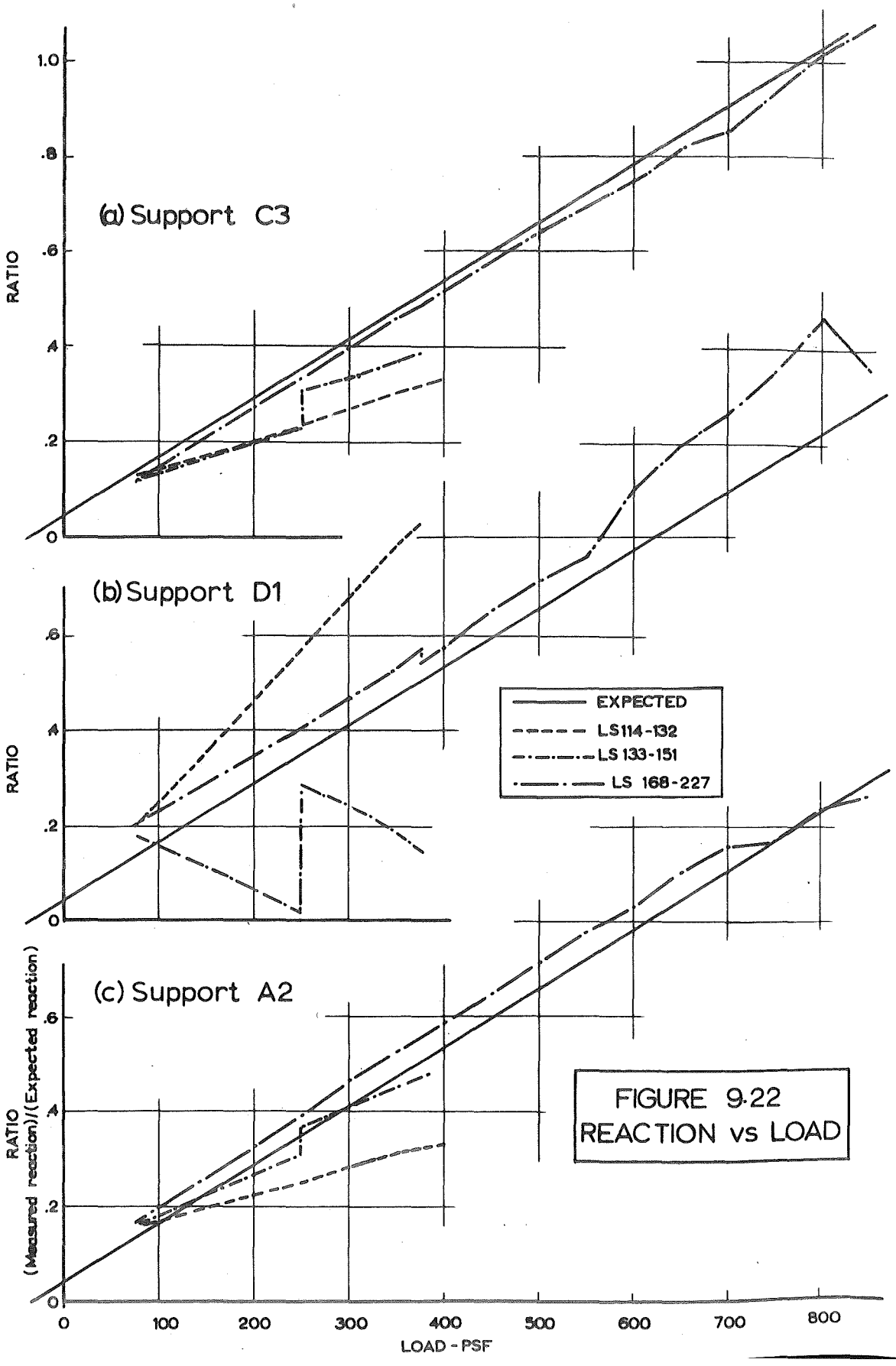


FIGURE 9.22
REACTION vs LOAD

effective loaded area) and the straight line joining the origin with the point (775, 1.0) provides a useful reference.

For equal load on all panels, the corner support reaction, D1, was uniformly higher than expected up to 550 psf, thus when the initial discrepancy was allowed for, the variation with load almost exactly corresponded to that of the expected reference line. After 550 psf the rate of increase of this reaction became greater at the expense of the other reactions. The degree to which this affected the other reaction was exaggerated by the scaling effect used to plot the reaction variation.

A detailed study of the variation of the reactions provided no reliable information as to the distribution of loading along the beams.

9.3.4.3 Method of Calculation of Line Moments from Reactions and Applied Loads

The moments, $M_1 \ldots M_{10}$, about lines 1....10 of Figure 7.5 (p.130) were calculated using the measured values of reactions and the known values of the loading pressures on the panels. Nominal values of applied load could not be used because the sum of all 16 reactions was always less than the sum of the products (nominal applied load x corresponding total available area), indicating that the bags did not exert pressure over the full area, rather 92-96 per cent of it. It was most likely that the unloaded area was in the region of the beams (at the edges of the

bags) but in calculating the line moments, load was assumed to act over the full area with reduced intensity. Calculation of the line moments was therefore both accurate and straightforward.

9.3.5 Moments

9.3.5.1 General

Two sources were available for the determination of moments in the slab. Strain readings were used (see Section 7.3.4.3) to compute the moment and normal force at sections of the slab and beams. The other source was the reaction values and applied load, which provided a means of determining the moment along a full width section of the floor.

Moment computation from the strain readings gave the values at particular sections whereas those computed from the reactions afforded only the total moment along the section line. The results of the latter method were inherently more accurate than those of the former. Comparisons between the two methods were made by summing the section moments across the floor and plotting the load-moment curves for both methods.

9.3.5.2 Basis of Calculation of Line Moments from the Sum of Section Moments

Consider the element of floor cut out by lines 2 and 3 of Figure 7.5. Each line cuts through four beams and exposes three lengths of panel edge. The total moment

acting along each of these lines, as given by the strain readings, was calculated by summing the individual beam and slab moments across the line.

Let Figure 9.23 represent one of the beams and enough slab section on either side of it to make the sum of the slab compression equal to the tension in the beam, with the following notation:

M'_b = moment in the beam at the support about the mid-depth, as calculated from the strain readings.

T'_b = tension in the beam at the support acting at mid-depth as calculated from the strain readings.

C'_{sum} = sum of slab compression over the length of slab considered such that $C'_{sum} = T'_b$.

m'_{sum} = sum of slab moments acting about the mid-depth of the slab, summed over the length of slab as defined by $C'_{sum} = T'_b$.

M_b, T_b, C_{sum}, m_{sum} are similar values at mid-span.

The moment of the exposed actions in the beam, M'_{total} is therefore given by

$$M'_{total} = M'_b + m'_{sum} - T'_b(D-D_s)/2 \qquad \ldots.(9.1)$$

and so across the full line 2, the moment is the sum of the computed beam moments <u>plus</u> the sum of the computed slab moments across the full width <u>minus</u> the sum of the products

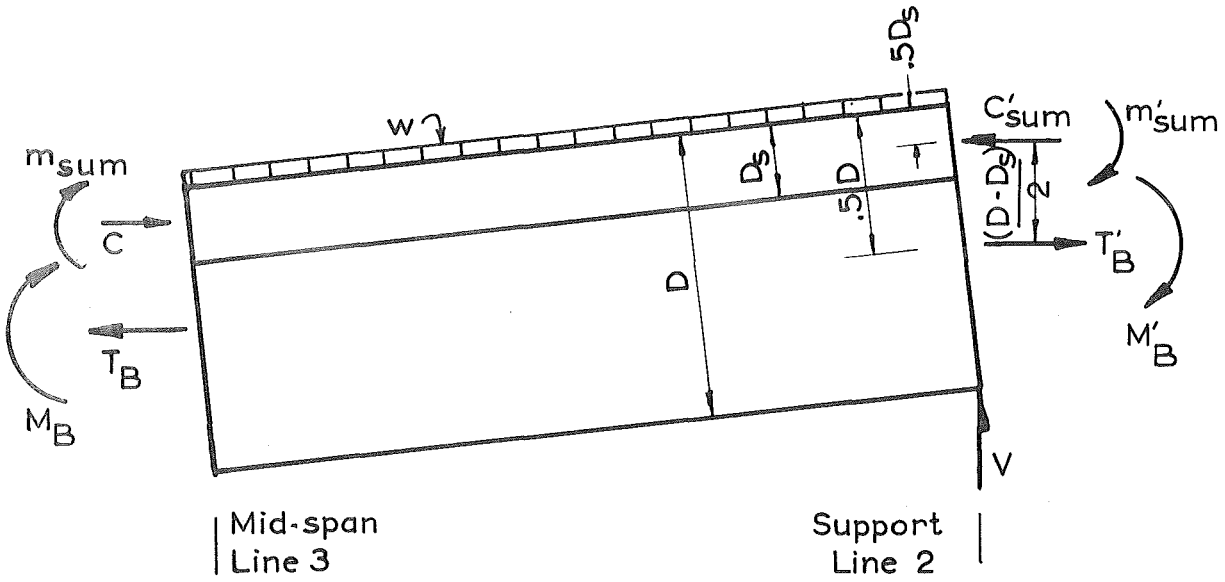


FIGURE 9.23 COMPUTED ACTIONS ON A TYPICAL SLAB AND BEAM ELEMENT

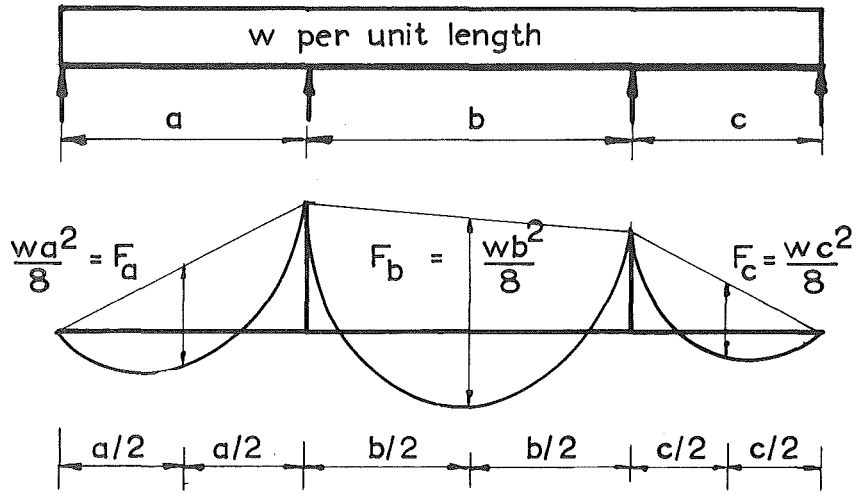


FIGURE 9.24 FREE MOMENTS

of $T'_b(D-D_s)/2$ for each beam, bearing in mind that D may vary from beam to beam.

At mid-span the total moment, M_{total}, of the actions exposed in the beam of 9.23 is

$$M_{total} = M_b + m_{sum} + T_b(D-D_s)/2 \qquad ....(9.2)$$

and a similar summation of these quantities, beam by beam yields the total moment along a line such as line 3.

For checking purposes, a most useful quantity is the "free" moment, which for any symmetrically loaded span is the average of the two support moments plus the moment at mid-span. This moment should equal the moment induced at mid-span by the same load on a simply supported span of the same length. The case of a uniformly distributed load is illustrated in Figure 9.24.

Referring to this figure and denoting the total moment at the opposite support (not shown) as M''_{total}:

$$\text{Free moment, } M_f = \tfrac{1}{2}(M'_{total} + M''_{total}) + M_{total}$$

$$= \tfrac{1}{2}(M'_b + M''_b) + \tfrac{1}{2}(M'_{sum} + M''_{sum})$$

$$-\tfrac{1}{2}(T'_b + T''_b)(D-D_s)/2$$

$$+M_b + m_{sum} + T_b(D-D_s)/2 \qquad ....(9.3)$$

9.3.5.3 Comparison of Line Moments

Each line cut through four beams, not all of which

were strain-gauged sufficiently to determine moments at the sections cut. The sum of moments in the beams cut by any line was computed by assuming complete symmetry of floor behaviour, e.g., when only two beams (one exterior and one interior) were suitably gauged, the sum of the two known moments was doubled. Unknown tension couples were similarly treated.

The slab moments, m_{sum}, were not known at all and for m'_{sum} only one edge of the centre panel was suitably gauged. Thus assessment of the contribution of slab moment was not at all accurate and in most cases the difference between the full moment as calculated from the reactions and the sum of beam moments only was examined to ensure that it was of reasonable magnitude.

Figures 9.25 to 9.28 show moment-load curves for lines 2, 3, and 4 calculated from reactions and applied loads and from strain readings. All curves are for increasing load from LS168 upward to LS227. Each figure is more fully described and discussed below.

Figure 9.25:

All curves in this figure are calculated from the reactions and applied load by the method described above (9.3.4). Line 1, line 2 and line 3 moments are shown individually, together with the free moment in the end span ($\frac{1}{2}$ line 2 + line 1) and that in the centre span ($\frac{1}{2}$(line 2 + line 4) + line 3). The latter may be seen to compare

favourably with the $wl^2/8$ values.

Line 3 moment increased linearly from the outset but curled over to reach a maximum value at approximately 800 psf. Line 2 accordingly showed the reverse tendency, increasing more sharply after 650 psf.

The larger value of mid-span moment initially suggested a relatively large EI value in this region, probably due to the contribution of flanges in the T- and L-beams, and the subsequent reduction in the rate of increase of moment was probably due to the decreasing role played by the flanges, and to the increased cracking at mid-span.

Figure 9.26:

Comparison of line 2 moments is made in this figure, the curve for moments calculated from the reactions and applied loads being the basis for comparison (curve 3).

Along line 2, only two beams were gauged to give values of beam tension and moment (gauges 133,134 in the exterior beam; 126,129 in the interior beam). Curve 1 is the sum of moments only in these two beams, calculated from the strain readings and doubled to allow for the other two beams. For curve 2, curve 1 values were reduced by the total value of the tension couples as given by Equation 9.1. The difference between curve 3 and curve 2 represents the sum of slab moments along line 2.

No slab edge moments were measured along line 2 but it is reasonable to assume that the centre panel edge moments will be approximately equal to those along the centre panel

edge at right angles to line 2. Gauges 118,119,120; 114,115; 116,117; showed nearly equal values of slab edge moment at LS227 and it is reasonable to take this value as acting along the whole length of the centre panel edge. Further, since no moment values were obtained for the edges of the centre-edge panel, the values of moment per unit length of edge obtained for the edge of the centre panel were taken as representative of the centre-edge panel values. The total length of edge over which this moment could act was thus $62.5 + 2(44.5) = 151.5$ inches.

At load stage 227 the slab edge moment per inch given by gauges 118,119 etc., (650 lb/in) required multiplication by 130 inches to make values of curve 2 + slab moments equal to curve 3. This same factor was applied to the slab moment at the other load stages, resulting in curve 4 which compares favourably with curve 2.

The factor of 130 inches implies a high value of moment (500 lb/in) along the short edge of the centre-edge panels. Some estimate of the feasibility of this value may be gained by comparison of the expected normal forces along these edges (340 lb/in. in the centre panel; 270 lb/in. in the centre-edge panels (see Figure 6.3)). The centre panel edge forces given at these sections from which the moments were taken are all of greater magnitude than expected at LS227. If it is assumed that the expected and actual membrane force values compare as well in the centre-edge

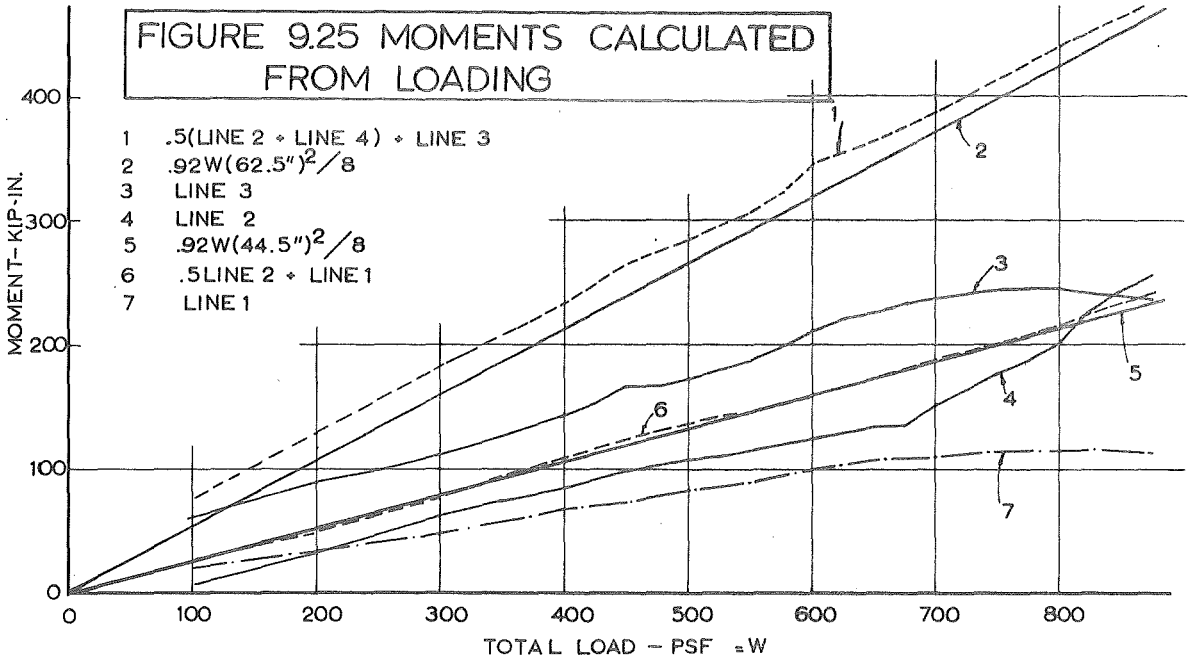


FIGURE 9.25 MOMENTS CALCULATED FROM LOADING
1 .5(LINE 2 + LINE 4) + LINE 3
2 .92W(62.5")²/8
3 LINE 3
4 LINE 2
5 .92W(44.5")²/8
6 .5LINE 2 + LINE 1
7 LINE 1
MOMENT-KIP-IN.
0
100
200
300
400
0
100
200
300
400
500
600
700
800
TOTAL LOAD - PSF =W

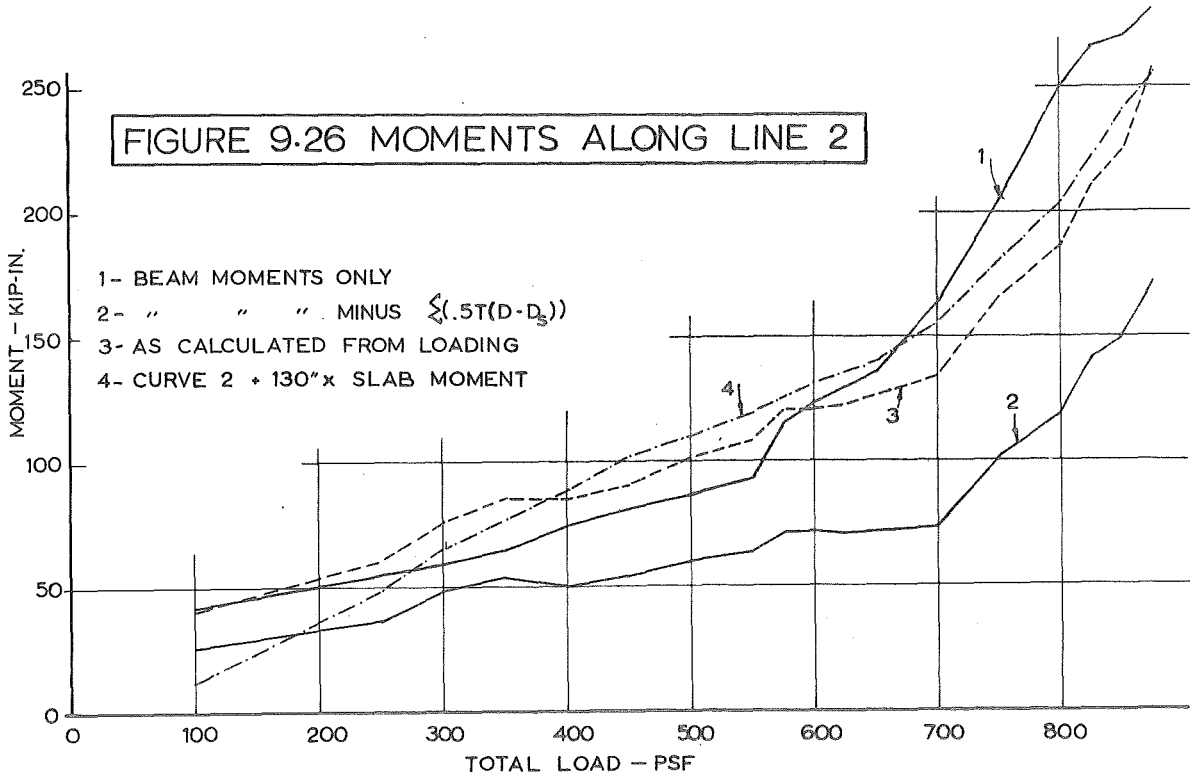


FIGURE 9.26 MOMENTS ALONG LINE 2
1- BEAM MOMENTS ONLY
2- " " " MINUS Σ(.5T(D-Ds))
3- AS CALCULATED FROM LOADING
4- CURVE 2 + 130"x SLAB MOMENT
MOMENT-KIP-IN.
0
50
100
150
200
250
0
100
200
300
400
500
600
700
800
TOTAL LOAD - PSF

panels, an enhanced moment of 500 lb/in along the short edges is reasonable.

Figure 9.27:

This figure shows line moment values for the middle sections of the floor in both directions (lines 3 and 8). The lower two curves are plots of the sum of beam moments only, in each case this sum comprising the two separate interior beam values and twice the one exterior beam value obtained. Both these curves fell well short of the curves calculated from the reactions (upper two curves).

The two middle curves compare far more favourably with the top pair, since for these the necessary addition of tension couples has been made, according to Equation 9.2. The difference remaining represents m_{sum} and is well within the capacity of the slab portion.

Figure 9.28:

The lowest curve (1) in this figure is the graph of the sum of beam moments only along line 3, again being twice the exterior beam value + the two separate interior beam values. No tension couple adjustment was made for this or for curve 2 which is a plot of line 2 moments. Curve 3 shows the sum of these. If it is assumed in Equation 9.3 that $M'_{total} = M''_{total}$, $T_B = T'_B = T''_B$ then this curve represents the total free moment less the portion of moment taken by the slab sections $(m_{sum} + \frac{1}{2}(m'_{sum} + m''_{sum}))$.

When 130" times the centre panel edge moment per unit

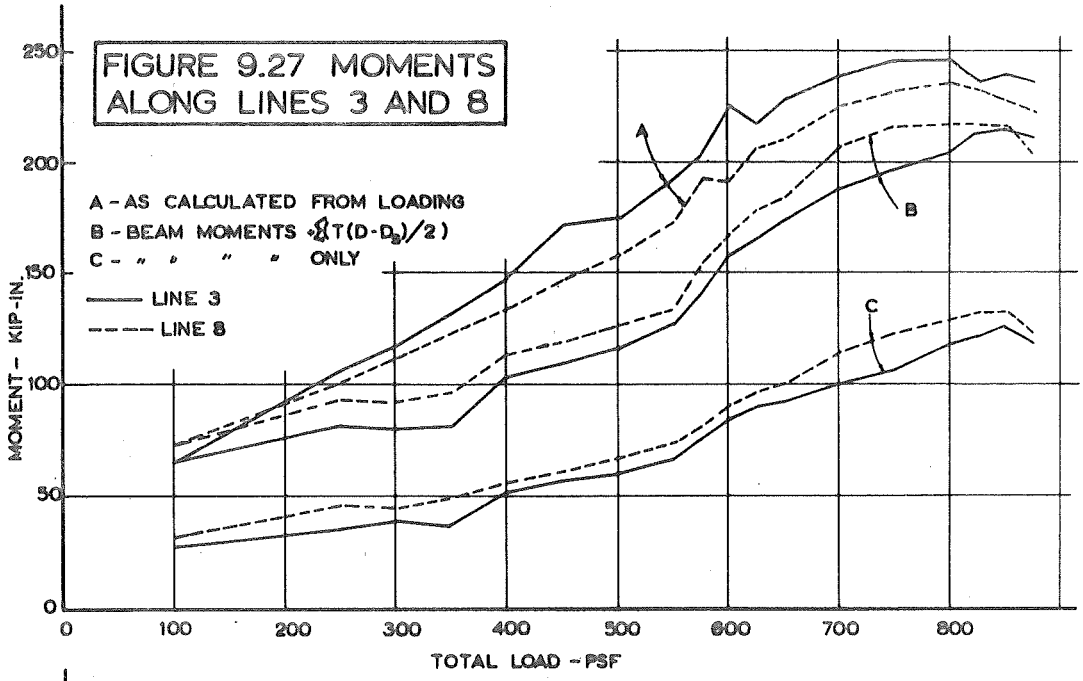


FIGURE 9.27 MOMENTS ALONG LINES 3 AND 8
A - AS CALCULATED FROM LOADING
B - BEAM MOMENTS $\frac{1}{2}T(D-D_s)/2$
C - " " " " ONLY
LINE 3
LINE 8
MOMENT - KIP-IN.
TOTAL LOAD - PSF
0
50
100
150
200
250
100
200
300
400
500
600
700
800
A
B
C

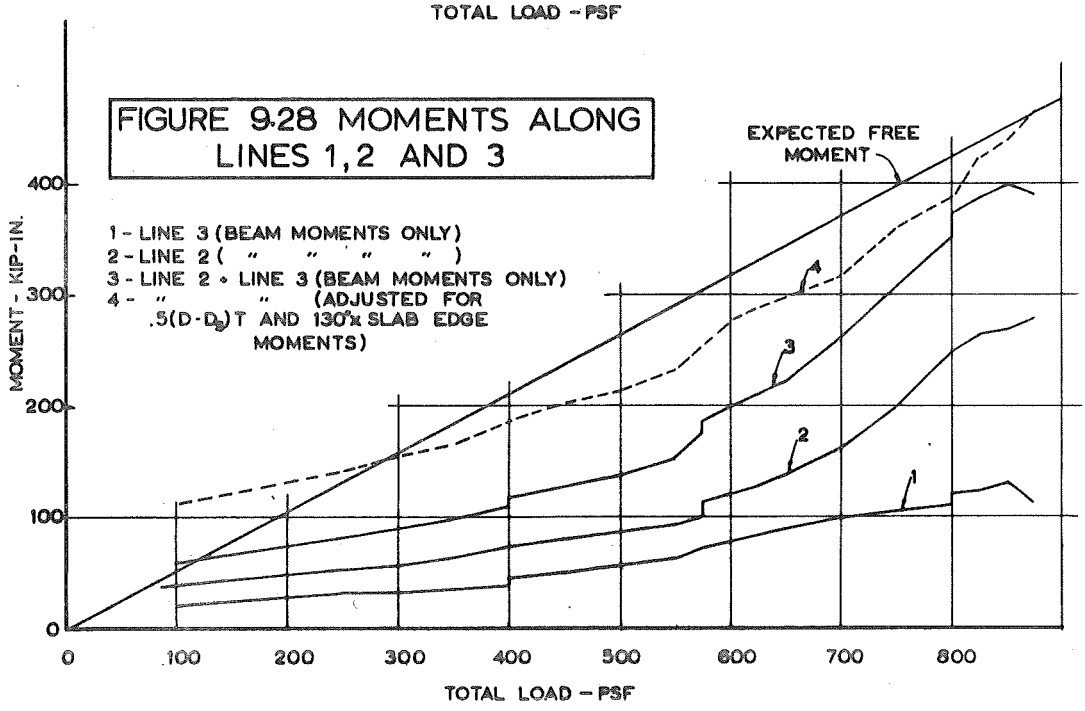


FIGURE 9.28 MOMENTS ALONG LINES 1, 2 AND 3
1 - LINE 3 (BEAM MOMENTS ONLY)
2 - LINE 2 (" " " ")
3 - LINE 2 + LINE 3 (BEAM MOMENTS ONLY)
4 - " " " (ADJUSTED FOR .5(D-Ds)T AND 130% SLAB EDGE MOMENTS)
EXPECTED FREE MOMENT
MOMENT - KIP-IN.
TOTAL LOAD - PSF
0
100
200
300
400
100
200
300
400
500
600
700
800
1
2
3
4

width is added to this curve, values are significantly in excess of the theoretical free moment (solid line). However, when each beam moment was adjusted separately for the $T_b(D-D_s)/2$ terms and the same slab edge moment term added, curve 4 resulted.

9.3.5.4 Variation of Section Moments with Load

Values of section moments as calculated from the strain readings are shown for several critical sections in Table 9.9, for increasing load in pattern 1 after LS168 and for critical load stages before LS168. Some of the former values are plotted in Figures 9.29 to 9.31 inclusive.

Figure 9.29 shows the beam moments plotted against load. For the exterior beam centre spans, the support moment rose far more sharply than the mid-span values. In the interior beam centre spans, values at support and mid-span showed marked equality up to 550 psf after which a sharp rise in support moment occurred and the rate of increase in mid-span moment fell. The values of design moment are marked in the figure and may be seen to compare favourably at the interior beam centre span and the exterior beam support. Values at the exterior beam mid-span were less than the design moment, while those at the interior beam support were greater.

In Figure 9.30, the moments at sections along the edge of the centre panel are plotted. The curves for gauge positions 118,119,120 and 114,115 (near the middle of the edge) are

TABLE 9.9 - MOMENTS AT SELECTED LOAD STAGES (CRACKED SECTIONS BF=1.0 FOR BEAMS)

* Assuming complete bond transfer.

**Concrete gauge not at mid-span.

STEEL GAUGE		BEAM MOMENTS - KIP-IN										SLAB MOMENTS lb.in/in.						
LSN	LOAD	71	73	70	72**	127	126	132	136	54	53	118*	116*	114*	112*	107*	105*	94*
32	225/2/75	9.1	12.9	11.6	12.1	-6.9	-5.0	-3.5	-3.8	+1.3	1.6	-124	-116	-82	-49	-67	-82	-86
57	225/3/75	7.4	10.3	11.0	10.0	-6.9	-5.0	-4.2	-6.4	6.4	6.1	-79	-82	-49	-25	-97	-103	-99
7A	225/1	9.6	15.4	13.0	13.0	-9.2	-7.1	-4.9	-6.7	4.6	4.3	-131	-129	-82	-40	-100	-114	-128
79	225/1	8.8	15.2	12.7	13.2	-9.2	-7.0	-5.0	-6.3	3.9	3.9	-141	-124	-83	-37	-103	-115	-130
84	350/1	15.4	10.8	17.2	14.3	-15.5	-12.5	-7.9	-10.1	6.5	6.3	-190	-179	-127	-51	-131	-165	-178
85	375/1	16.9	12.2	18.4	16.3	-16.9	-13.2	-8.9	-11.4	7.2	7.0	-205	-193	-135	-58	-142	-171	-188
96A	225/1	12.3	8.7	13.1	12.1	-11.6	-7.8	-6.4	-7.6	3.2	3.7	-128	-109	-71	-21	-87	-113	-119
98	375/1	16.8	12.4	17.8	17.4	-17.9	-13.6	-9.4	-11.6	6.2	6.4	-206	-192	-114	-43	-128	-169	-188
104	375/5/75	13.8	9.9	14.9	15.5	-9.4	-5.4	-3.7	-4.5	-1.0	.1	-194	-172	-86	-26	-71	-114	-130
123A	400/2/75	11.3	8.2	12.2	14.1	-11.9	-6.9	-4.7	-4.0	-5.3	-3.8	-213	-184	-81	-23	-62	-107	-134
142B	375/3/150	10.1	7.3	11.3	13.2	-13.4	-6.4	-6.3	-10.5	3.9	4.9	-175	-132	-36	19	-114	-151	-176
153A	225/1	8.6	6.2	9.7	11.8	-11.2	-4.0	-4.8	-7.2	-1.6	.4	-162	-123	-30	19	-83	-113	-135
155	375/1	13.9	10.4	18.9	17.5	-18.9	-11.7	-8.6	-12.5	2.3	3.7	-208	-176	-57	18	-112	-166	-190
158	450/1	23.0	18.6	23.5	23.8	-30.0	-23.9	-9.5	-15.0	3.4	6.4	-293	-241	-141	-94	-167	-229	-302
168	75	9.8	8.5	10.6	10.3	16.0	12.2	8.4	7.9	1.0	3.5	-114	-80	-7	-53	-48	-77	-109
171A	225	15.1	12.1	15.5	15.2	21.4	16.2	10.3	10.6	1.9	4.6	-187	-145	-47	-73	-82	-128	-170
183A	225	13.7	11.0	14.9	14.2	21.5	16.4	10.8	10.7	1.6	4.3	-184	-143	-44	-72	-79	-129	-170
185	275	15.4	12.0	16.6	15.7	23.4	17.6	11.5	11.7	1.9	4.7	-212	-165	-63	-83	-102	-148	-195
187	325	17.1	13.7	18.4	17.4	25.3	19.5	12.4	12.8	2.3	5.3	-237	-192	-78	-90	-118	-170	-213
189H	375	18.9	15.2	20.2	19.0	27.6	21.7	13.1	13.9	2.6	5.3	-270	-213	-97	-93	-132	-188	-239
		22.7	17.3	22.6	19.4	30.6	23.4	13.5	14.7	3.3	6.4	-270	-217	-97	-103	-146	-196	-232
191	425	24.3	18.6	24.5	20.6	32.9	25.2	14.1	16.0	3.8	6.9	-293	-234	-104	-113	-170	-217	-257
193	475	26.6	20.5	26.8	22.8	35.2	27.4	15.3	17.3	4.0	7.5	-310	-256	-124	-142	-182	-242	-283
199	525	29.4	23.6	30.1	25.9	38.5	30.2	16.4	19.4	4.6	8.2	-341	-285	-145	-246	-200	-265	-302
200	550	38.2	24.9	31.9	27.4	40.3	32.0	17.2	20.0	5.0	8.4	-370	-305	-159	-286	-213	-277	-326
		32.7	27.2	35.7	30.1	37.3	39.2	18.5	23.3	5.6	8.5	-370	-305	-165	-424	-208	-302	-323
208	575	35.6	29.0	38.5	32.8	38.1	41.4	20.0	24.4	6.6	9.3	-384	-340	-180	-472	-221	-322	-313
213	600	38.1	31.5	40.3	36.0	40.6	44.0	20.5	25.9	7.0	9.6	-405	-362	-195	-494	-236	-335	-297
214	625	40.3	35.4	42.0	38.4	45.2	50.6	16.8	28.5	6.9	9.5	-388	-369	-205	-519	-270	-385	-241
216	675	44.3	38.9	49.5	44.5	51.6	60.5	20.8	29.7	7.4	10.9	-451	-447	-263	-586	-358	-443	-316
218	725	47.6	42.1	57.0	46.5	59.9	75.0	26.9	30.0	7.8	12.9	-494	-492	-281	-726	-375	-428	-374
220	775	48.7	43.5	63.2	47.6	74.8	91.9	29.5	37.5	9.4	13.0	-515	-494	-352	-869	-356	-434	-405
224	775	51.0	45.7	66.6	47.5	80.3	96.1	31.4	38.4	11.5	13.2	-512	-506	-418	-923	-370	-476	-420
225	800	52.4	47.5	68.2	47.2	-	99.2	33.3	40.5	11.6	12.8	-537	-554	-511	-1024	-401	-514	-445
226	825	54.8	50.3	71.3	46.9	98.6	102.5	33.7	42.2	12.0	13.0	-560	-555	-575	-1175	-418	-459	-474
227	850	50.8	40.4	67.0	39.1	108.8	106.5	34.0	43.8	12.2	13.1	-650	-659	-1953	-1866	-542	-541	-509

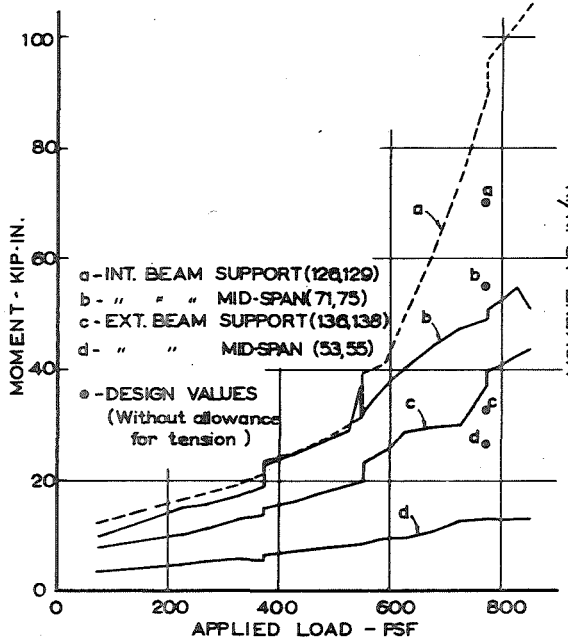


FIGURE 9.29 MOMENTS AT BEAM SECTIONS

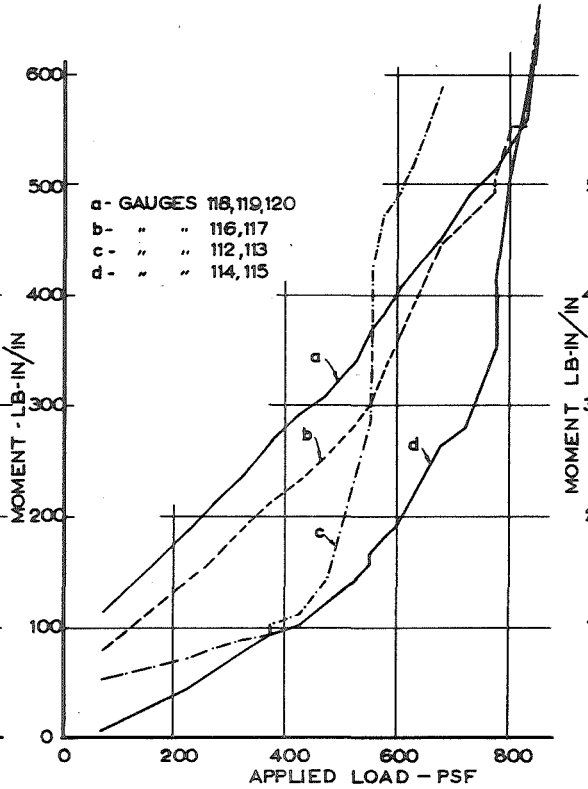


FIGURE 9.30 MOMENTS AT EDGE OF CENTRE PANEL

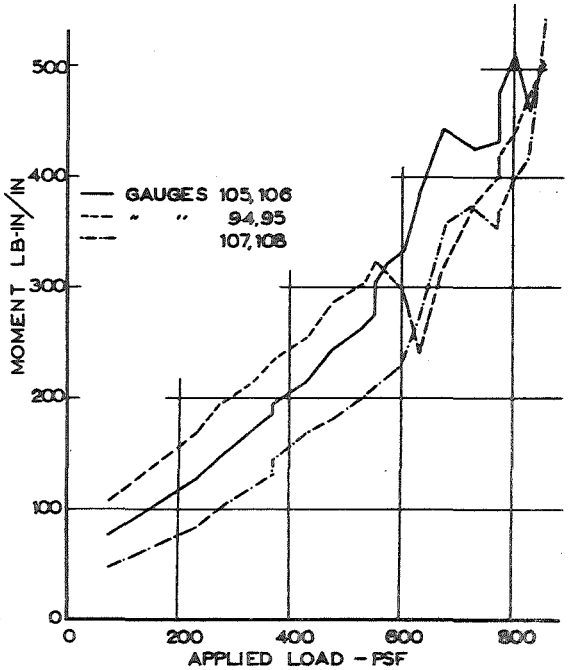


FIGURE 9.31 MOMENTS AT EDGE OF CENTRE-EDGE PANEL

similar but towards the corners the initial rate of increase of moment was lower. Membrane compression became enormous near the corners towards the end of the test, a fact which explains the steep rise in moments in this region.

Moment values at sections along the interior long edge of the centre-edge panel showed good grouping as Figure 9.31 shows. The effect of the crack along the centre of each of these panels was evident in the discontinuity in the curve for gauges 94,95 which were located on the line of this crack. The moment values of 400 lb"/" at 775 psf indicate considerable compressive membrane action in this direction.

9.3.5.5 Discussion

Line moments calculated from the measured reactions and applied loads were expected to be reliable and accurate and were shown to be so. Values of line moments computed from the strain readings showed similar trends to the reaction-load line moments and the values compared well.

The effect of beam tension and slab compression on the line moments was shown to be large and the conclusion that the strain moments compared well with the reaction-load moments was based on values of strain moments in beam sections only, corrected for the couple induced by the beam tension and slab compression.

The assumption that concrete in a cracked section

carried no tension in regions of tensile strain once the extreme fibre strain exceeded the nominal cracking strain could have been the cause of the general tendency for values computed from the strains to rise slowly until relatively high loads were reached. Cracks did not form exactly at the gauge positions and bond transfer from steel to concrete between the crack and the gauge position would have reduced the tension in the steel, while at the same time inducing some tension in the concrete. The loss of steel tension was accounted for inherently in the strain reading but the "no tension" assumption ignored the corresponding tension in the concrete and therefore the section moment and tension would have been underestimated in the most likely case of this tension having its centre of action near the tension steel. At higher loads, further cracking would result in reduction of the force transferred by bond and better values from the computation would result.

Residual strains at LS168 have clearly led to high initial values, though not in all cases is this fully applicable. Cracking of the floor in previous tests caused redistribution of moments which remained effective when load was removed, causing significant alteration in the initial conditions of subsequent tests.

The effect of variation of flange width on the computed moments at the mid-span sections was small. For a

section at the mid-span of an interior beam section, the maximum change in moment due to an increase in flange width from 1.0 to 3.0 times the web width was 14 per cent. All values plotted are for a flange width equal to the web width.

9.3.5.6 Conclusion

Line moments calculated from reaction values and applied loads showed good agreement with expected values. Lack of slab moment data made direct comparison of line moments difficult. Nevertheless, favourable results were obtained from comparisons of line moments calculated from the two independent methods.

Beam section moments followed the same trend as the line moments and compared well, overall, with the design values.

Mid-span moments for both lines and sections tended to be large initially showing a slower rate of increase at higher load while support moments showed the reverse tendency.

Slab moments were well in excess of Johansen values due to enhancement by compressive membrane action. Variation of these moments with load was approximately linear for sections near the middle of the edges but values nearer the corners showed slow development initially followed by a sharp rise at higher load values.

All moment values calculated from strain readings

contained inherent inaccuracies of sufficient size to make it difficult to draw firm conclusions from their variation with load, but good results were obtained in the comparisons of these values with the moments calculated from the reactions and applied loads. The slow rise in moment in some beam sections was attributable to the transfer of steel force to concrete, a factor not accounted for in the method of moment computation from the strain readings.

9.3.6 Membrane Action Effects

9.3.6.1 General

The effects of membrane action were the subject of particular study in this experiment. Analysis of strain readings, deflections, beam and slab section moments and axial forces provided quantitative data on the membrane action in the floor while effects observed both during and after the test provided qualitative information on the action of membrane forces.

Values of forces computed for the slab and beam sections compared well with those expected but no useful information was obtained from these as to the effect of varying load pattern on the distribution of membrane forces. However, study of the centre panel deflection and the strain in the bottom steel at the middle of the centre panel did reveal some differences.

Effects of sustained loading were negligible, except for the centre panel where deflection and strains increased

by detectable amounts and redistribution of compressive forces took place.

In Section 9.3.6.2 the effects of membrane action on each of the floor elements is examined in detail, Section 9.3.6.3 deals with the comparison of membrane forces, and some aspects of particular interest are discussed in Section 9.3.6.4. Table 9.10 shows values of net force on critical sections at selected load stages.

9.3.6.2 Effect of Membrane Action on Floor Elements

Compressive membrane action caused enhancement of the load carrying capacities of all three panel types. At what was deemed to be failure of each panel type, the following values of the ratio of actual load to Johansen load were obtained:

Centre panel:	2.18 cf 2.0	required in design.
Centre-edge panel:	1.55 cf 1.35	" " "
Corner panel:	1.46 cf 1.00	" " "

Although values for the centre-edge and corner panels were affected by large beam deflections, it is clear that for these panels, the enhancement due to membrane action was significantly in excess of that required.

Compressive forces in the panels gave rise to considerable tensions in the beams, thereby reducing their flexural capacity.

The fact that the panel types had unequal ultimate loads eased the burden of tension carried by the beams,

TABLE 9.10 - SECTION FORCES AT SELECTED LOAD STAGES

		BEAM FORCES KIPS										SLAB FORCES - lb/in.						
STEEL GAUGE →		71	73	70	72	127	126	132	136	54	53	118	116	114	112	107	105	94
LSN	LOAD																	
32	225/2/75	1.6	4.0	2.7	2.6	-.2	1.1	-1.1	-.5	-1.1	-.7	-106	-112	-68	-30	-52	-68	-80
57	225/3/75	1.1	2.6	2.6	2.2	-.2	.8	-1.1	-1.6	.1	.1	-59	-68	-30	-17	-84	-102	-90
7A	225/1	1.2	4.8	2.9	3.0	-1.2	.5	-2.3	-1.9	-1.0	-.6	-128	-122	-68	-33	-93	-106	-118
79	225/1	1.0	4.8	2.9	2.6	-1.8	.1	-2.7	-2.3	-1.4	-1.0	-128	-106	-71	-23	-102	-109	-125
84	350/1	2.7	1.5	3.5	1.5	-2.4	-.2	-2.4	-1.8	-.6	-.7	-181	-154	-115	-36	-128	-141	-181
85	375/1	3.0	1.8	3.6	2.0	-2.5	-.3	-2.0	-1.4	-.6	-.3	-175	-166	-110	-27	-131	-159	-181
96A	225/1	2.3	1.6	3.0	1.9	-2.4	-.4	-2.7	-1.4	-1.5	-1.4	-118	-90	-37	-4	-83	-103	-121
98	375/1	3.0	1.9	3.8	2.4	-2.8	-.5	-2.6	-1.3	-.9	-.9	-178	-163	-76	-12	-118	-153	-181
104	375/5/75	2.6	1.7	3.5	2.5	-3.7	-1.0	-4.4	-1.9	-3.2	-2.9	-169	-132	-53	11	-64	-106	-125
123A	400/2/75	1.9	1.5	3.1	2.0	-4.9	-2.2	-7.2	-2.5	-5.5	-4.7	-170	-142	-38	20	-40	-84	-137
142B	375/3/150	1.6	.9	2.8	1.6	-6.4	-3.0	-8.1	-4.5	-3.5	-3.0	-141	-100	10	58	-106	-128	-175
153A	225/1	1.3	.8	2.6	1.5	-6.9	-2.9	-8.8	-4.2	-4.9	-4.1	-132	-76	25	58	-71	-103	-140
155	375/1	2.2	1.2	3.5	2.2	-6.0	-1.4	-6.8	-2.6	-3.6	-3.0	-124	-87	33	84	-100	-144	-187
158	450/1	4.4	4.0	5.0	3.8	-1.9	2.9	-2.4	-1.0	.8	1.4	-118	-51	73	67	-120	-131	-232
168	75	2.4	3.0	3.2	3.0	.6	3.7	-1.2	.8	1.0	1.7	+9	+52	+125	75	3	5	-33
171A	225	3.4	3.7	4.1	3.5	.2	4.0	-1.3	.5	1.2	1.9	-78	4	119	71	-41	-31	-99
183A	225	3.0	3.3	3.9	3.2	-.4	3.7	-2.3	.0	1.0	1.7	-25	10	128	74	-32	-34	-99
185	275	3.2	3.4	4.1	3.3	-.7	3.5	-2.3	-.1	1.0	1.7	-50	3	130	70	-42	-62	-115
187	325	3.5	3.7	4.4	3.5	-.9	3.5	-2.4	-.3	1.0	1.7	-66	-19	115	79	-61	-69	-140
189H	375	3.8	3.9	4.6	3.7	-1.0	5.0	-.7	-.4	1.1	1.6	-69	-26	117	70	-73	-94	-158
		4.6	4.8	5.1	5.1	-.1	5.0	-.7	+.6	1.6	2.3	-79	-8	117	69	-86	-94	-140
191	425	4.8	5.0	5.3	5.3	-.3	5.0	-.6	.5	1.5	2.4	-88	-30	123	69	-99	-95	-156
193	475	5.2	5.3	5.6	5.6	-.2	5.2	-.6	.4	1.7	2.6	-113	-36	122	40	-105	-111	-175
199	525	5.5	5.8	8.9	6.1	.2	5.8	-.5	.5	2.0	3.0	-116	-37	118	-66	-100	-120	-175
200	550	5.7	6.1	6.1	6.2	.4	7.8	.3	.6	2.3	3.8	-135	-68	105	-97	-110	-130	-188
		6.0	6.1	6.7	6.9	5.4	7.8	.3	1.2	2.6	3.3	-159	-69	87	-222	-11	-89	-152
208	575	6.9	7.2	7.3	7.9	6.6	8.9	.8	1.8	3.2	4.4	-159	-113	74	-201	-20	-69	-122
213	600	7.8	7.9	7.4	8.3	7.2	10.5	.4	3.0	3.5	5.2	-195	-123	59	-290	-6	-98	-100
214	625	8.0	8.9	7.5	8.6	8.0	11.3	3.2	3.1	3.7	5.3	-171	-144	28	-308	-22	-162	-21
216	675	8.5	9.4	8.4	9.2	9.9	12.4	5.1	4.9	4.3	6.2	-246	-234	-58	-308	-141	-222	-71
218	725	8.1	10.0	7.9	9.7	12.8	13.6	6.9	8.5	4.8	7.2	-290	-314	-82	-569	-162	-234	-159
220	775	7.7	9.6	7.2	9.9	13.0	15.3	10.2	10.4	5.5	7.3	-308	-320	-149	-722	-161	-254	-195
224	775	7.4	9.4	6.0	10.5	14.7	14.6	11.9	10.7	6.1	7.3	-317	-328	-234	-812	-177	-293	-210
225	800	7.2	9.0	5.5	10.7	-	13.5	12.7	9.8	6.4	7.2	-334	-416	-255	-933	-213	-352	-228
226	825	6.7	8.5	4.4	11.1	13.6	12.4	12.6	9.2	6.5	7.2	-370	-390	-422	-1099	-234	-272	-258
227	850	4.9	7.3	3.3	10.6	9.8	10.7	12.4	8.5	6.5	7.1	-462	-507	-2017	-1899	-378	-375	-308

particularly the centre spans of the interior beams, because the degree of development of compressive forces in each panel type was different, i.e., by the time the centre-edge and corner panels were in greatest need of compressive membrane action enhancement, the centre panel had failed and formed a tensile net which tended to reduce the tension in the beam spans supporting it.

The interaction of elements was important in assessing the effects of membrane action in the floor, a fact revealed in the following element by element analysis of the effects of membrane action on the floor behaviour.

(i) Centre Panel

The development of membrane forces in this panel was slow at low load levels but increased very rapidly after the Johansen load was exceeded. As the collapse load was approached, evidence of a significant reduction in membrane compression near the centre of the panel was detected. Edge forces continued to rise during this stage and strains which indicated the level of "circumferential" compression near the edges increased sharply.

The variation of edge force with increasing load beyond LS168 is shown in Figure 9.32, from which it may be seen that the delay in rise of compressive force is more marked near the corners of the panel.

Values at 775 psf compare reasonably with the predicted average force of 340 lb/in. The rate of increase

in this edge force showed no sign of reduction while the load was increasing, but the level of compression did drop with the push-through failure of the centre panel.

Figures 9.11 and 9.12 (pp. 192-3) illustrate clearly the transfer of compressive force from the middle region to the edge. Zones of crushing on the diagonals reach only half way along, decreasing almost linearly in width. An increase in crack width is then evident. These photographs were taken after this panel was loaded well into the tensile membrane range but they only exaggerate an effect which was evident at initial failure.

Strains parallel to the edge provided clear evidence of the increasing compression and subsequent decrease. Readings of gauges placed in this direction were examined and the readings of the two rosette stations were resolved into components parallel to and perpendicular to the edge. The variation of some of these with load is shown in Figure 9.33. This figure shows the variation for channel 78 and the components perpendicular to gauge 14 and gauge 25, the latter showing larger values by virtue of its closeness to the diagonal, where compression was higher.

For comparison, values for gauges 82 and 76 are plotted. Gauge 76 represents the strain in the top of the beam, directly above the web, and values are very much less than those for gauge 78, indicating that the strain in gauge 78

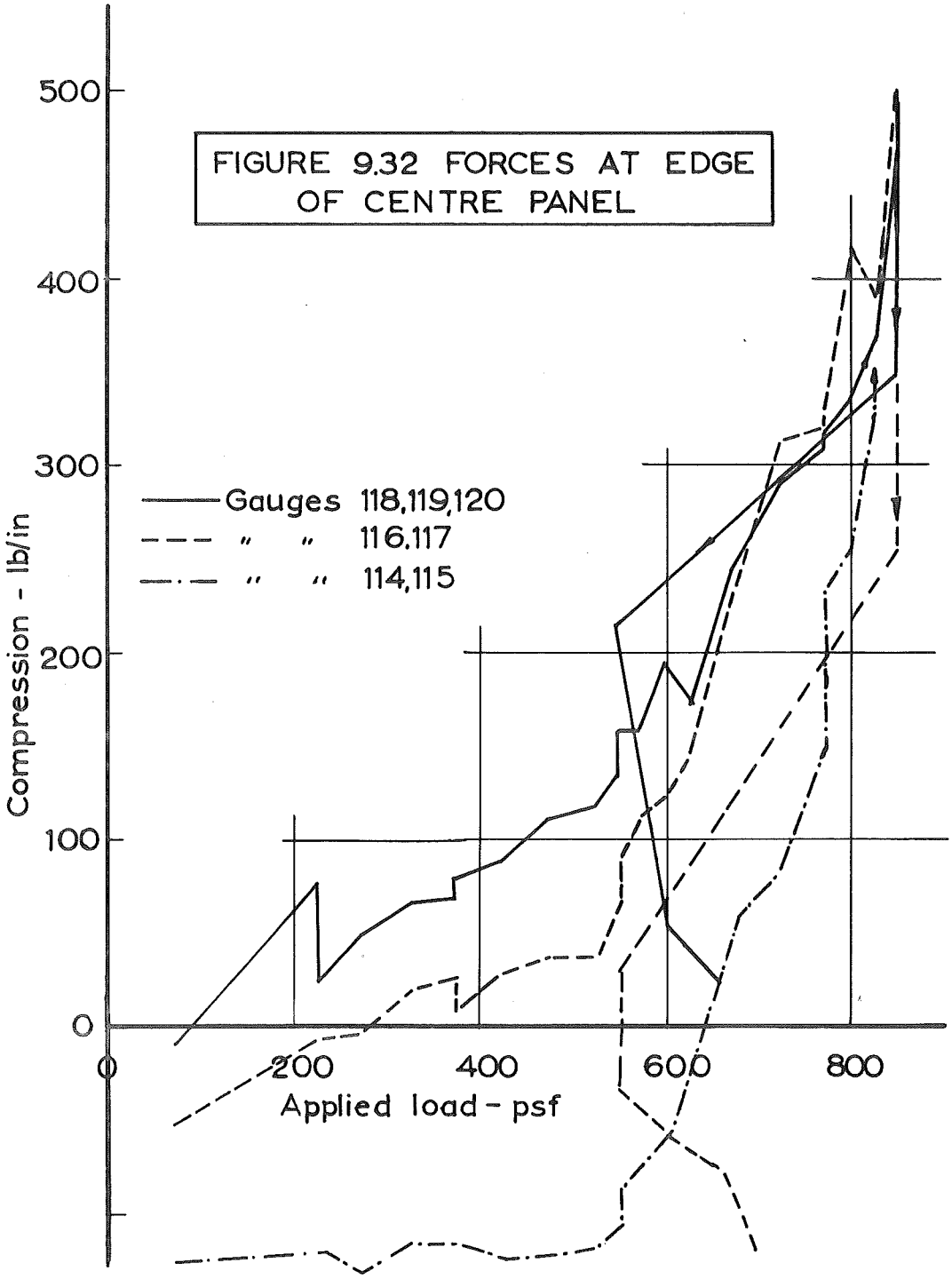


FIGURE 9.32 FORCES AT EDGE OF CENTRE PANEL
500
400
300
200
100
0
Compression - lb/in
Gauges 118,119,120
" " 116.117
" " 114,115
0
200
400
600
800
Applied load - psf

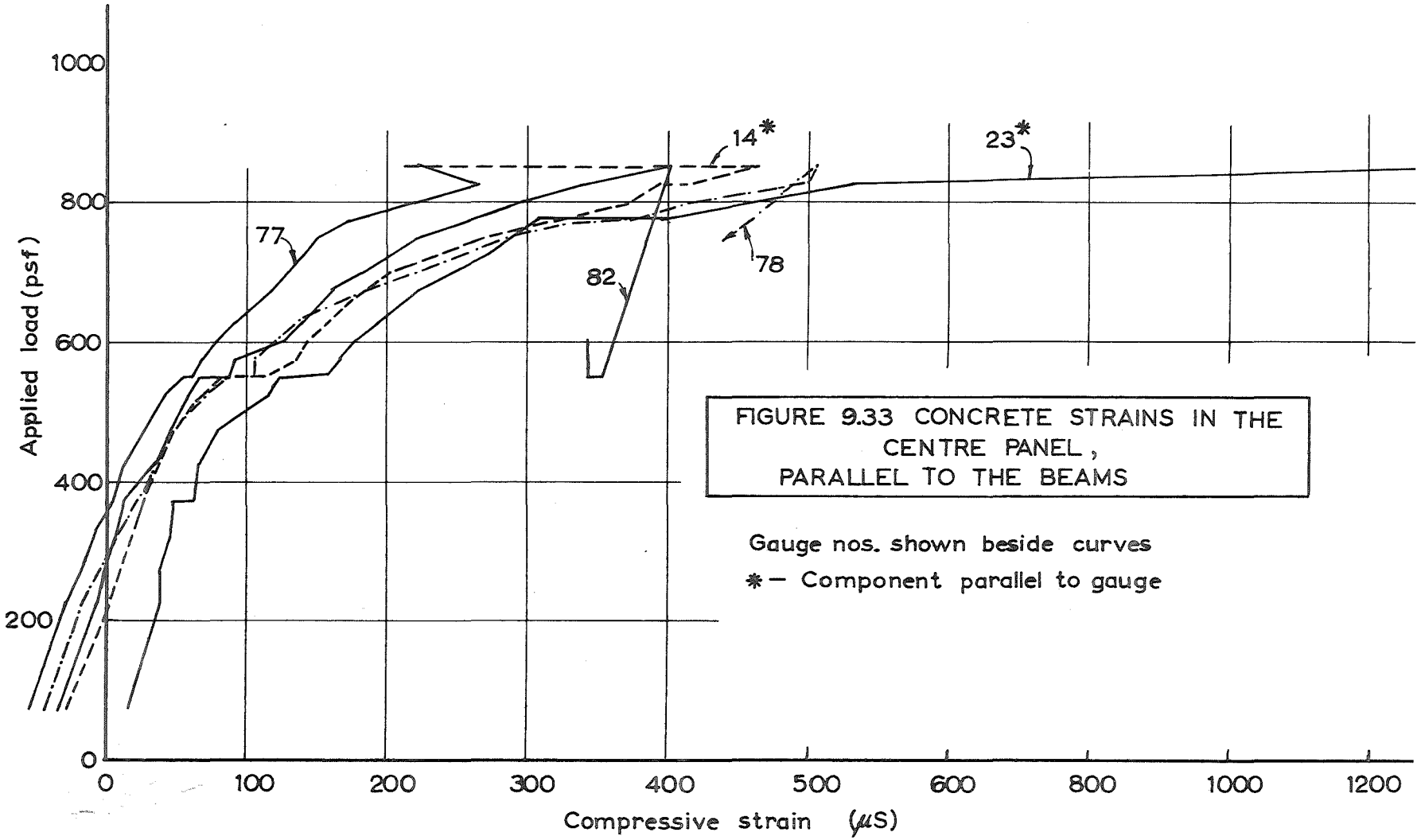


FIGURE 9.33 CONCRETE STRAINS IN THE CENTRE PANEL, PARALLEL TO THE BEAMS

was due principally to centre panel action and not to compression in the T-beam flange. Gauge 82 shows a little of this effect of "circumferential" compression. Whereas the strain in gauge 78 became tensile as the centre panel failed, gauge 82 strain remained compressive.

Study of Figure 9.11 reveals that the spread of the tensile membrane is greater away from the diagonals, revealing an important difference between circular and square slabs in this respect. Comparison of the curves for strain in gauge 78 and the strain perpendicular to gauge 25 illustrates that this effect was present at the time of initial failure, and again this effect is merely exaggerated in the photograph.

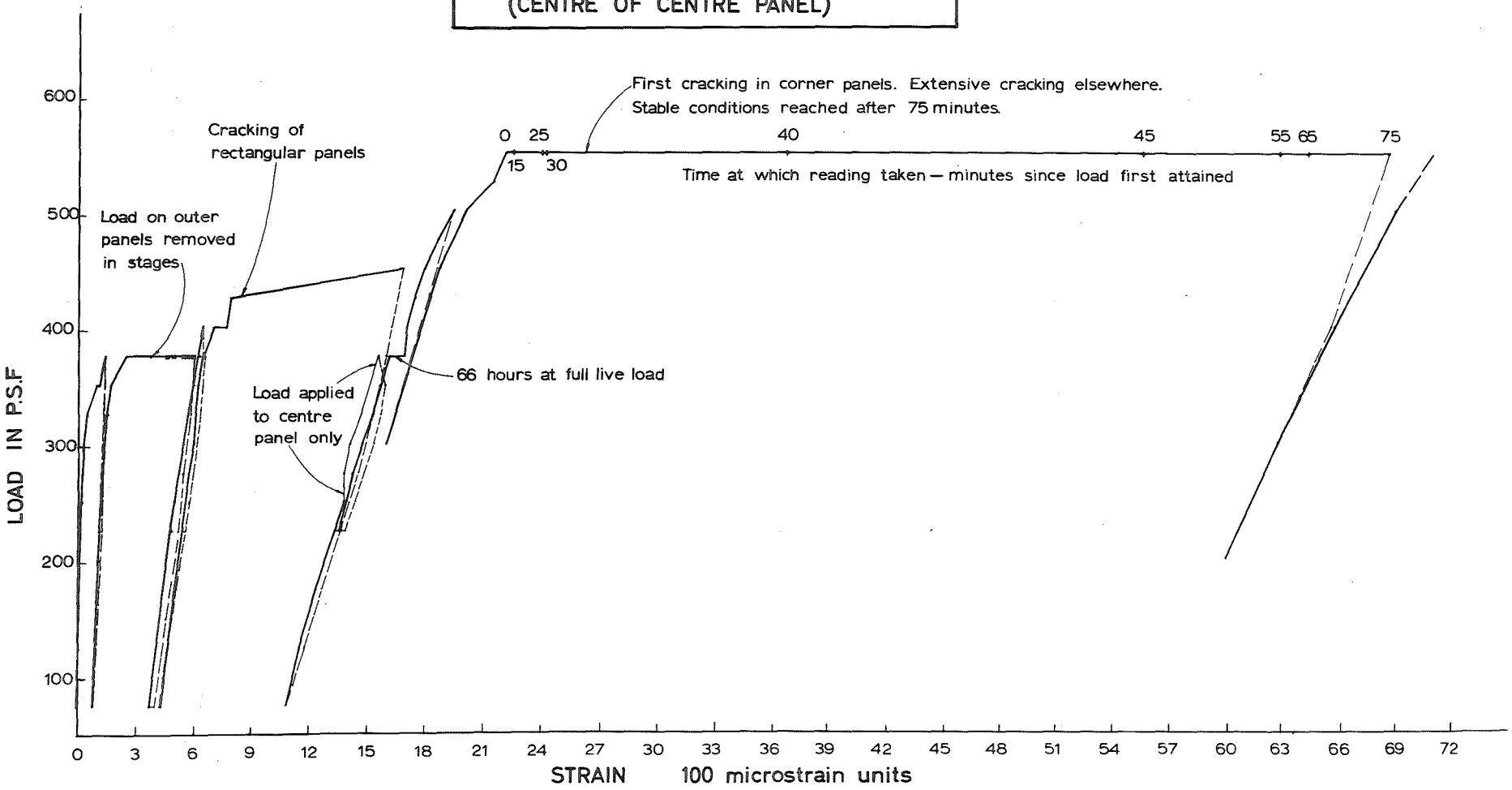
The effect of surround stiffness on the centre panel behaviour was particularly marked at three stages during the test programme as described earlier.

The effect of loss of surround stiffness on steel strain at the middle of the centre panel is shown in Figure 9.34. Causes of the large increases are shown on the figure.

At 550 psf readings of strains were taken several times and the variation of strain with time during this unstable period was quite erratic; i.e., there was no suggestion that the cause of the increase in deflection was due to creep deformation of the surround.

This graph shows clearly the effect of having a lower

FIGURE 9.34
LOAD v. STRAIN — GAUGE 6
(CENTRE OF CENTRE PANEL)



load on the outer panels. In spite of reduced moment restraint at the edge of the centre panel, the increased surround stiffness resulting from the lower load on the outer panels caused a slower rise in strain with load.

The effect of the application of 375 psf for 66 hours is shown to be small and a recovery to the original path on application of further load is evident. The increasing stability with time during this test was illustrated previously (see Section 9.2.4.6).

The membrane forces perpendicular to the diagonals appeared to vary approximately linearly. Some assessment of these forces was made by measuring the depth of crushing along the diagonals at the end of the test. Results of this investigation are given in Figure 9.35. Measurements were taken along each of the four diagonals. The average force per unit width was determined and plotted against the distance from the centre. Variation is almost linear and very large values are reached near the edge of the panel.

(ii) Centre-edge Panels

These panels sustained loads well in excess of their Johansen loads due to enhancement by compressive membrane action but evidence of this was not as clear as in the centre panel.

Compressive forces were expected parallel to the long side and although no provision for measurement of these

forces was made, the presence of tension in the centre spans of the exterior beams indicated that panel compression in this direction was considerable. Figure 9.36 shows the values of measured compression along the interior long edge of one of these panels, plotted against load. The rate of rise was steadier than for similar sections in the centre panel but there was still the evidence of a steeper rise for loads greater than 600 psf.

Values are considerably less than those in the centre panel but indicate substantial compressive membrane action in this direction, although much of this force was a reaction to the centre panel forces. At the end of the test programme the panel mechanism was considerably developed as Figures 9.11 and 9.12 show. These Figures show clearly the zones of concrete crushing in the end spans of the interior beams and a study of the panel crack joining two of these zones revealed the presence of mambrane action of a different nature. Near the beams, this crack was present on the underside of the panel only, while the concrete at the upper surface above this crack had crushed. At its middle, the crack penetrated the full slab depth so that the panel sections along the crack were subject to high compression near the beams and tension in the middle.

(iii) Corner Panels

The assumption that membrane action would not enhance the load capacity of these panels was clearly conservative.

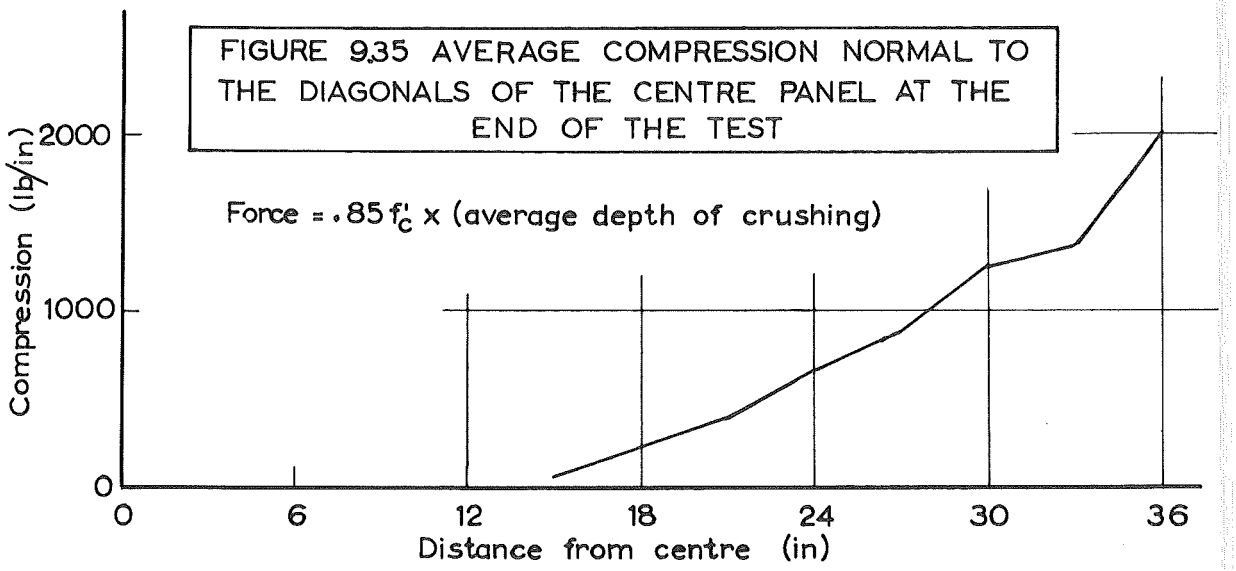


FIGURE 9.35 AVERAGE COMPRESSION NORMAL TO THE DIAGONALS OF THE CENTRE PANEL AT THE END OF THE TEST

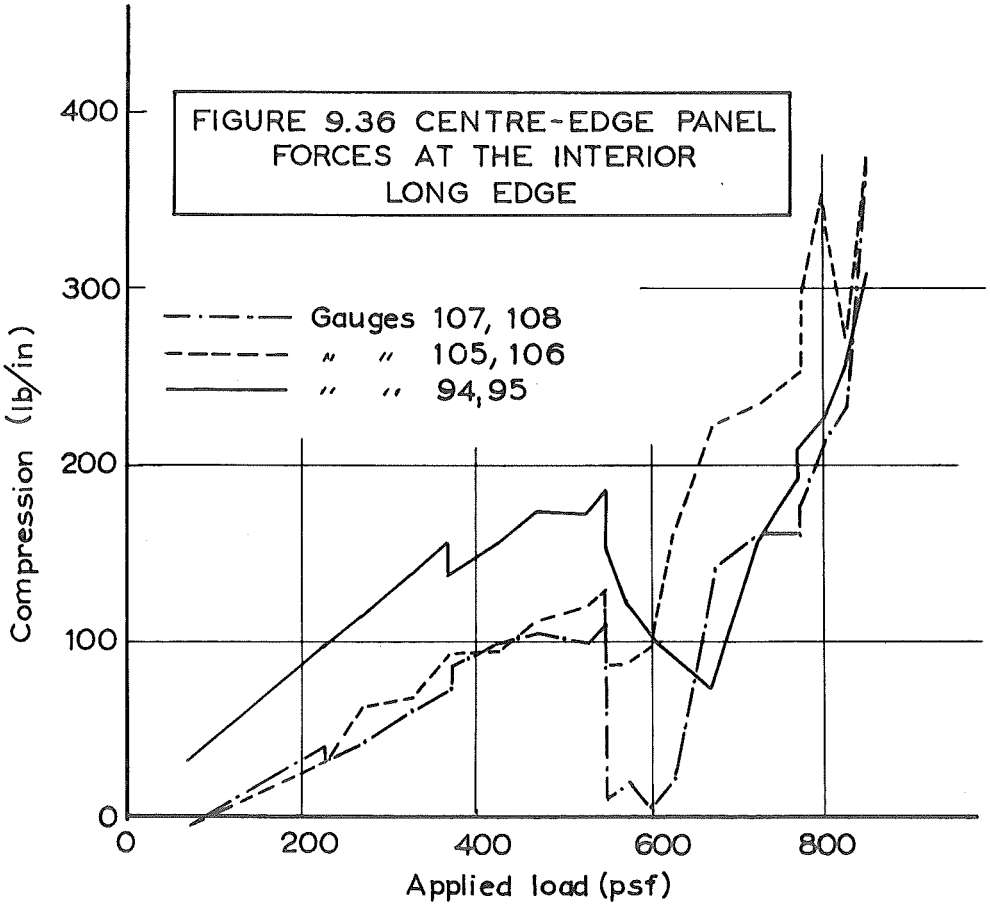


FIGURE 9.36 CENTRE-EDGE PANEL FORCES AT THE INTERIOR LONG EDGE

The lower span to depth ratio partially compensated for the more flexible surround of these panels. The T-beam flange effect described for the centre-edge panels was also evident in these panels and the panel mechanism was not as fully developed even at the end of the test programme, suggesting that more membrane action enhancement may have been available if the beams had not failed.

The low steel strains at the exterior edges of the panels indicate the degree of development of the full yield moment along these edges. Extra membrane compression would account for this, the moment required being taken by the moment of concrete compression force about the mid-depth rather than by steel force moment. High concrete compression along these edges affects the torque induced in the exterior beams for the reasons discussed in Section 4.3.

(iv) Interior Beams

In the absence of any net axial tension, the centre spans of these beams were capable of carrying a far greater load than 800 psf but in fact steel strain readings reached yield values at this load, indicating the presence of large tensions in the spans.

Analysis of section strains showed larger values at the support than at mid-span as may be seen from Table 9.10 and Figure 9.37(a). The rate of rise in beam tensions followed a similar pattern to that followed by the panel

edge compressions, tensions being small at low load levels and rising steeply in regions of higher load.

During the test, the tension gave evidence of its presence with the formation of steeply inclined shear cracks (see Figure 9.10). . Values of tension measured in the end spans were not reliable and the behaviour of these spans during the test showed no conclusive signs of the tension implied by the presence of compressive forces along the interior long edge of the centre-edge panels.

After the centre panel pushed through to form a well developed tensile membrane, the effect of reduction of induced tension was clear. Deflections and mid-span steel strains reduced considerably, but this was not wholly due to the effects of reduced tension because at this time, the end spans were showing signs of development of plastic hinges in the positive moment regions and the resulting increase in support moment tended to produce the same effect as the reduced tensions. As loading progressed this effect became more marked and the tensions continued to reduce.

(v) Exterior Beams

Visually detectable effects of membrane action on these beams were few and confined to the centre spans. The forces measured at the sections showed a similar trend to the interior beams in their variation with load, as may be seen in Figure 9.37(b). Values were appreciably less

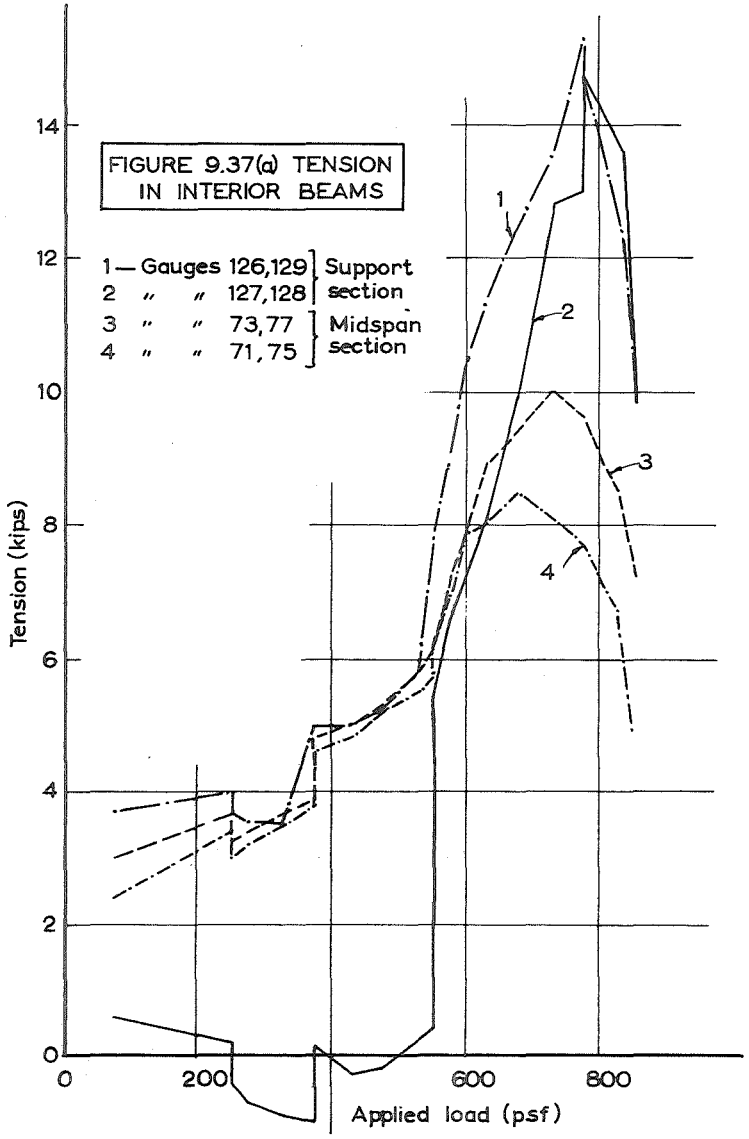


FIGURE 9.37(a) TENSION IN INTERIOR BEAMS
1— Gauges 126,129 } Support
2 " " 127,128 } section
3 " " 73,77 } Midspan
4 " " 71,75 } section
Tension (kips)
Applied load (psf)
0
2
4
6
8
10
12
14
200
600
800
1
2
3
4

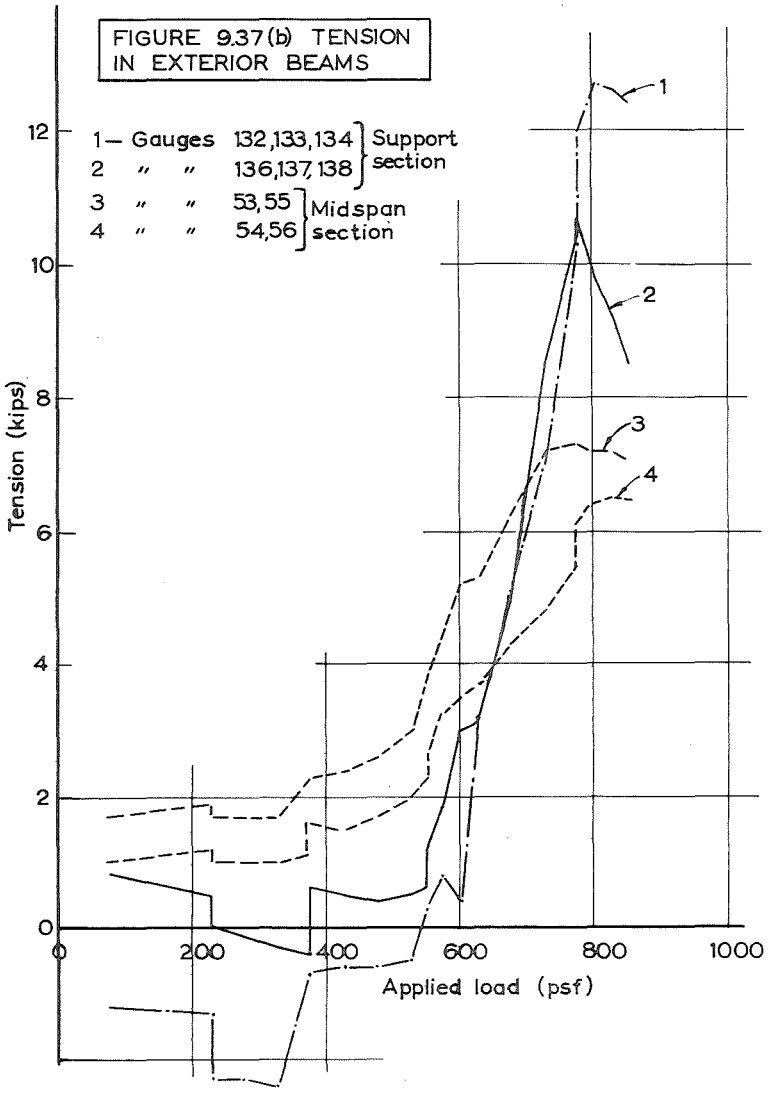


FIGURE 9.37(b) TENSION IN EXTERIOR BEAMS
1— Gauges 132,133,134 } Support
2 " " 136,137,138 } section
3 " " 53,55 } Midspan
4 " " 54,56 } section
Tension (kips)
Applied load (psf)
0
2
4
6
8
10
12
200
400
600
800
1000
1
2
3
4

than interior beam values and again the mid-span tensions were less than those measured at the support. In spite of this, even the lowest mid-span value was larger than the design tension.

The presence of membrane forces in the centre-edge and corner panels reduced the torque which would normally have been induced in the exterior beams and slowed the development of steel strains at these edge sections. It was only after the formation of plastic hinges in the end spans of the interior beams that the torsion in the end spans of the exterior beams showed up clearly. The reduction in torque to be carried would cause the beams to have greater flexural strength but the presence of axial tension would offset this advantage.

9.3.6.3 Comparison of Measured Membrane Forces

Membrane forces were compared in two ways: Panel and beam forces were compared with the design values, and the beam tensions compared with the sum of slab compressions along a line traversing the full width of the floor.

(i) Comparison of Membrane Forces with Those Expected

In designing the beams, the mean membrane forces were taken as 340 lb/in for the centre panel; 270 lb/in in the long direction of the centre-edge panels; zero in the short direction of the centre-edge panels and in the corner panels.

Figure 9.32 shows that, at 775 psf, centre panel forces

were close to 340 lb/in. No measurement of forces was made in the long direction of the centre-edge panels but Figure 9.36 shows clearly that the membrane action force in the short directions was underestimated and had a value of approximately 200 lb/in at 775 psf, set up principally as a reaction against the compressive forces in the centre panel.

Expected and actual beam tensions did not show particularly good agreement at 775 psf as may be seen from Table 9.11:

Table 9.11. Beam Tensions at Predicted Ultimate Load (775 psf).

	Expected Value	Measured (Mid-span)	Measured (Support)
Interior Beam Centre Span	17.6^K	8.7^K	14.9^K
Exterior Beam Centre Span	5.2^K	6.6^K	11.4^K
Total	22.8	15.2	26.3

(ii) Comparison of Tensions with Compressions

Line 2 was the only line along which sufficient data existed to allow such a comparison to be made. Figure 9.38 shows the variation of the sum of support section tensions in the exterior and interior beam sections cut by line 2. As in the summing of moments along this line, the figure of 130" was used to factor the panel edge forces per unit

width. The force at each of the panel edge sections was weighted according to the length of centre panel edge it covered (half the distance to the next gauged section on either side).

Between 550 psf and 775 psf, the values compared well but after 775 psf, panel compression continued to rise while the tension in the beams fell. In this comparison it was assumed that the centre-edge panel forces were of a similar order to that expected, which leaves room for considerable variation. However, unreliable strain readings in the panel edge sections seem to be the only possible source of this divergence of values. Values of compression at the panel edge did fall sharply as the push-through failure took place and continued to fall as the tensile membrane was forced to spread from the centre. The curves show good correlation of rates of increase for the greater part of the load range.

9.3.6.4 Conclusions and Discussion

In spite of some inconsistent results, the measured tensions and compressions and the variation of strain readings with load served to illustrate how enhancement of panel strength by membrane action was achieved and the effect it had on the supporting structure.

The mechanism by which panel compression was resisted by beam tensions was clearly active. The presence of compressive membrane action in the corner panels and the short

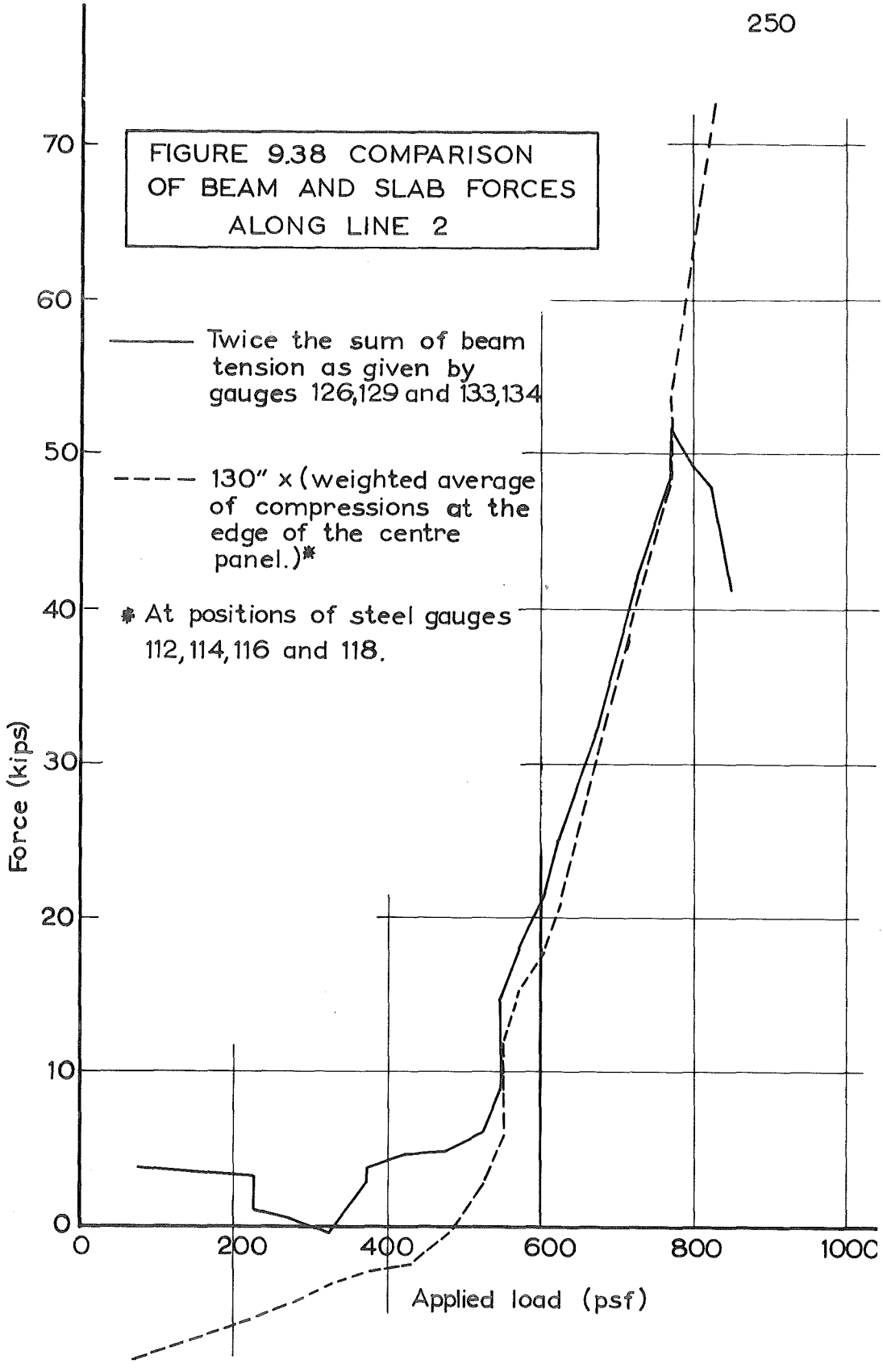


FIGURE 9.38 COMPARISON OF BEAM AND SLAB FORCES ALONG LINE 2
Twice the sum of beam tension as given by gauges 126,129 and 133,134
130" x (weighted average of compressions at the edge of the centre panel.)*
* At positions of steel gauges 112, 114, 116 and 118.
Force (kips)
Applied load (psf)
0
10
20
30
40
50
60
70
0
200
400
600
800
1000

direction of the centre-edge panels produced a more complex distribution of membrane forces than would have resulted from the simple mechanism assumed in the design of the floor.

Beams would have shown greater distress if all panels had reached failure simultaneously since all panels would then have exhibited maximum compressive membrane action.

Cracking, especially initial cracking, of the panels surrounding the centre panel had a marked effect on the centre panel behaviour: The centre panel deflection increased with the loss of surround stiffness.

As centre panel deflection increased, membrane compressive forces normal to the diagonals increased near the corners but decreased towards the centre of the panel.

The deflection at failure of the centre panel was almost equal to the panel depth, as compared with .5D used in Park's equations. The deflections of the beams had little to do with this high value. The more flexible surround clearly allowed greater deflection, while the development of high compression near the edges of the slab provided sufficient enhancement for the panel to sustain the required load in spite of a small central tensile membrane region. The low reinforcement content meant that a relatively low compressive force was needed to produce the required enhancement and the high span to depth ratio and low surround stiffness combined to affect the geometry

of the mechanism in a way that allowed the development of the tensile membrane before concrete crushing occurred. These factors also led to the higher stability in the centre panel, though at the expense of load enhancement. The instability brought by a stiffer surround was seen at LS200 when the deflection of the centre panel increased in jumps and it was clear that had the surround not cracked and become less stiff the ultimate load of the centre panel would have been greater than 850 psf.

The large difference between measured tensions at the mid-span and support sections of the beams could be due, in part, to the effect of horizontal shear along the junction of beam and panel. Further difference could have resulted in the different accuracies of the "no-tension" assumption in the computation of moments due to the different flexural bond requirements at these points.

CHAPTER 10

DISCUSSION OF TEST RESULTS

10.1 SUMMARY

The effect of membrane action on the behaviour of the model floor was the subject of particular interest. The preceding three chapters have dealt with the design, construction, instrumentation and behaviour under load, of the nine-panel model floor. In this chapter the principal findings of the test are discussed. Particular reference is made to the adequacy of the design method. General conclusions as to the behaviour of the floor and the suitability of the design method are drawn.

10.2 DISCUSSION OF TEST RESULTS

10.2.1 Beam Behaviour

Without question, the behaviour of all spans of all beams was satisfactory at service load. Flexural steel in the end spans was known to be excessive and it was the behaviour of the centre spans of both interior and exterior beams which was of chief interest. That all the additional longitudinal steel placed in these spans was required to resist the induced tensions was evidenced by the high

tensions measured and the high level of steel strains recorded simultaneously at mid-span and at the support, immediately prior to the failure of the centre panel.

The behaviour of these centre spans showed that the assumption that the concrete would take no shear was conservative for the interior beams at least. This was probably true for the exterior beams but the incomplete development of yield moments along the edges of panels adjoining these spans reduced the torsional load on the exterior beams and the situation was not as clear.

The proportion of the total tension taken by the exterior beams at 775 psf was larger than calculated in design. Design values, computed assuming the two corner and one centre-edge panel to be a continuous beam of constant flexural rigidity, were 17.6^{K} and 5.2^{K} for the interior and exterior beam respectively, a ratio of 3.4 to 1. Had the deep surrounding beam, formed by the outer panels, been assumed rigid and the tensions distributed according to the concrete section areas of the beams, values of 12.8^{K} and 10^{K} would have resulted giving a ratio of 1.28 to 1. Ratios of measured values were 1.32 at mid-span and 1.30 at the support. Both methods of calculation are simplifications but the measured values suggest that the latter method is a closer approximation to the actual relative distribution of tension.

10.2.2 Lateral Restraint of the Edges of the Centre Panel

Outward movements of the elements surrounding the centre panel had a marked effect on the centre panel behaviour. The outer panels clearly contributed to the lateral surround stiffness by flexural and shear action. The fact that cracking of the undersides of the outer panels produced large increases in centre panel deflections, strains and cracking, was a vivid illustration of this. The reduction in lateral stiffness produced by this cracking was not measured but the sharp change in centre panel behaviour after cracking suggested that the uncracked surround would have had sufficient lateral stiffness to enhance the load well beyond that finally attained.

10.2.3 Centre Panel Behaviour

The behaviour of this panel at service load was very satisfactory but an illustration of the possible effects of surround stiffness loss which could occur with time was obtained when the load was raised 75 psf above the total service load of 400 psf. Cracking of the panels surrounding the centre panel caused large increases in strains, deflections and cracking in the centre panel. The possibility that this could have resulted from sustained service loading can not be overlooked, but the centre panel did show adequate stability during the application of service load for 66 hours.

The increase in membrane compression normal to the edges was sharper at higher loads, most probably as a result of the high cracking load and the greater tendency for the edges to spread outward after underside cracking.

With the loss of lateral stiffness of the surround, edge compression reduced and the deflection increased, but the sensitivity of the panel to further loss of surround stiffness was reduced. There was an increased tendency for the panel to form a tensile net at the centre, supported by an outer region of high compression. With very stiff surrounds, much greater enhancement factors than 2.0 may be achieved for lightly reinforced panels and the failure is far more unstable. The failure of the centre panel in this case was not sudden, due to the gradual spread of the tensile membrane region and large deflection which took place before very high compressive forces normal to the diagonals crushed the concrete in these regions and brought about failure. It was because this region of high compression did not extend the full length of the diagonal and because the deflection at the middle was already high that "failure" was comparatively gentle.

The ability of the centre panel to sustain more than twice its Johansen load in this practical situation was encouraging, especially in view of the near equality of experimental and predicted ultimate loads.

10.2.4 Centre-edge and Corner Panel Behaviour

These panels sustained well in excess of 800 psf due to enhancement by compressive membrane action. Values of measured membrane forces suggested that membrane action enhancement was active in both directions. The low level of hogging moment along the exterior long edge indicated that enhancement due to membrane action was larger than expected. Two possible causes account for the low moments along this line.

Membrane forces perpendicular to this edge would have reduced the torsion in the exterior beam and at the same time enhanced the moment at the edge beyond that indicated by the low level of steel strains.

If no compressive membrane forces had existed perpendicular to the beam at the edge of the slab, the edge moments would have been very low and the load carried by membrane action in the long direction would have had to be greater. Hogging moments would not develop because of the reduced torsional stiffness of the exterior beams after cracking.

Which of these situations applied was not clear. Large membrane forces were measured perpendicular to the interior long edge and for equilibrium it appears that forces perpendicular to the exterior long edge must be of similar magnitude. However, it is unlikely that the exterior beams alone could withstand a lateral force of

200 lb/in without deflecting sideways.

It seems more likely that only small compressive membrane forces acted normal to the exterior long edge and that the large forces in this direction at the interior long edge were distributed to the beams in the manner shown in Figure 10.1, leaving very little compressive membrane force reaction against the laterally flexible edge beam.

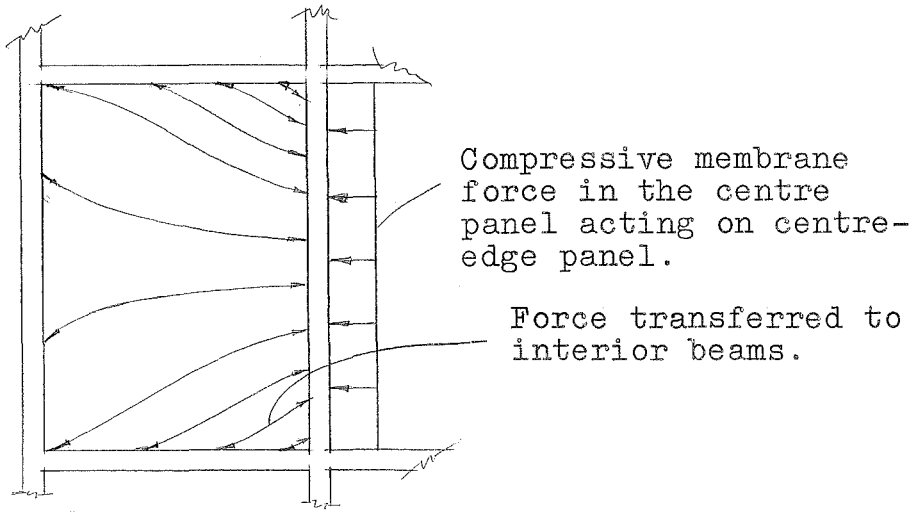


FIGURE 10.1. MEMBRANE FORCE DISTRIBUTION IN SHORT DIRECTION OF CENTRE-EDGE PANEL.

Compressive membrane action accounts for the high load capacity of the corner panels, although in this case membrane action was not allowed for in either direction. The low span to depth ratio and the relatively higher lateral stiffness of the edge beams (due to their shorter spans and to the effect of the extra steel placed in sections where cutoff could not be achieved) favoured the

development of compressive membrane action. Again, forces perpendicular to the exterior edges of the slab could not develop to any large degree and the reaction due to the centre-edge panel membrane action could enhance the load in the manner shown in Figure 10.2.

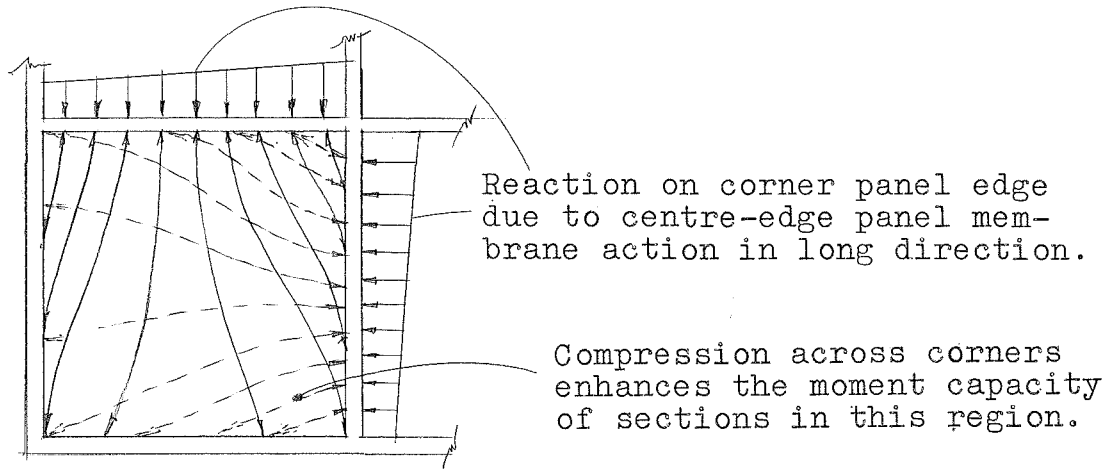


FIGURE 10.2. CORNER PANEL MEMBRANE FORCES.

10.2.5 General Behaviour of Floor

The method of design for the centre panel and beams proved adequate in that the expected loads were sustained and the extra steel placed in the beams was required. The interaction of elements was seen to be of critical importance when membrane action is to be relied upon to enhance the load carrying capacity of slab panels. Had the enhanced capacities of the outer panels all been 850 psf, the centre panel may not have carried this load. Increased deflection of the outer panels would have reduced the

lateral stiffness of the surround restraining the centre panel edges. Such a situation could have been achieved by increasing the size of the outer panels but this would have meant designing the corner panels with an enhancement factor substantially greater than 1.0. The effects of an increase in outer panel size would be beneficial to the centre panel initially but after the outer panels cracked and their deflection increased, the advantage of greater breadth of surround would be lost. Had all panels shown approximately the same load capacity, beam tension would have been higher as a result of the simultaneous action of high membrane forces.

Extrapolation of the results of this test is therefore difficult in view of the unknown effect that transverse loading of the outer panels has on their lateral stiffness. However, the results indicated that it would be possible to assess the contribution of membrane action provided due allowance was made for the sensitivity of the panels to loss of surround stiffness.

10.2.6 Measurement of Moments and Forces at Slab and Beam Sections

The methods used to measure forces and moments at sections by means of strain readings proved satisfactory. The performance of the method in this test pointed to several ways in which the method could be improved.

Measurement of concrete strain must be made over a

length sufficient to average the effects of aggregate size. In lightly reinforced slab sections the length over which very high concrete strains occur is much smaller than the desirable length for gauges. Furthermore, in any section, measurement of concrete strain at the point where crushing will occur, must be subject to doubt when high strains are reached because of the steep strain gradient likely to occur along the length of the gauge. It appears more reliable to place the concrete gauge in a position of low strain gradient and relatively low maximum concrete strain.

In the centre panel, the compression perpendicular to the diagonals reached a very high value and increased with distance from the centre. Measurements of this compression during the test would have been valuable, especially when the initial failure of the centre panel was imminent.

In tests carried out over a period of days, electrical drift and time effects in the concrete are likely to introduce errors into strain readings. Reduced sensitivity to such errors may be achieved by placing gauges in regions of relatively high strain.

In cases, such as in the centre panel of this floor, when membrane forces will be only moderately high, tests of short duration would probably yield more reliable results.

10.2.7 Technical Aspects

The methods used for recording and measuring reactions,

strains and deflections were entirely satisfactory.

The use of water in the loading bags presented problems in the manufacture of absolutely water-tight bags but this did not outweigh the advantage of safety arising from the use of water instead of air in the pressure bags. The simplicity of setting and maintaining the load with water-filled bags proved a great advantage. The flexibility of the reaction frame did reduce considerably the sensitivity of the loading system to rapid fall-off in load and although this meant that the falling branch of the load-deflection curve of the centre panel could not be followed exactly, the use of water permitted satisfactory control of load during failure.

10.3 CONCLUSIONS

On the basis of the behaviour of the model floor under load and the above discussion, the following conclusions as to the behaviour of the floor and design method were drawn.

(i) The design method for the panels proved satisfactory but left no margin for deterioration of behaviour of the centre panel under the action of service load for an indefinite period.

(ii) Compressive membrane action enhanced the load carrying capacities of all panels. The corner and centre-edge panels carried well in excess of the required 800 psf.

In the centre panel, compressive membrane action more than doubled the load capacity and enabled it to perform satisfactorily at a total service load of 400 psf.

(iii) Membrane forces measured at the edge of the centre panel were of the same order as those predicted by the theory due to Park.

(iv) The deflection of the centre panel at failure was approximately equal to the slab depth and occurred after tensile membrane forces had developed at the centre.

(v) Only moderate lateral restraint was provided by the panels surrounding the centre panel, resulting in large deflection at failure and the formation of a partially self-equilibrating system of a central tensile region supported by an outer region of compression.

(vi) Cracking of the panels surrounding the centre panel caused a significant loss of lateral stiffness.

(vii) Compressive membrane forces in the floor panels were carried almost entirely by tension in the beams. Outer panels provided stiffness against outward bowing of the surround but carried little or no tension after they had cracked.

(viii) The tension induced in the beams was of the same order as designed for.

(ix) It is conservative to neglect shear taken by the concrete in beams carrying axial tension but some account must be taken of the reduced shear capacity due

to the effect of axial tension.

(x) Membrane action in the outer panels suppressed the formation of hogging yield moments along those edges supported by exterior beams: the panel deflection required to develop sufficient membrane action was less than that required to develop full hogging yield moments against the torsionally flexible edge beams.

(xi) Stability of the centre panel under 66 hours of sustained service load was more than satisfactory but extrapolation of this result to predict behaviour under loading sustained indefinitely is difficult in view of the sensitivity of the centre panel behaviour to very small increases in outward movement of the panels surrounding it.

(xii) Had the outer panels been larger, their increased deflection and cracking at any given load would have reduced the surround stiffness even further, and the simultaneous demand of all panels for high membrane action enhancement would have increased the tension induced in the beams.

(xiii) Measurement of compressive membrane forces perpendicular to the diagonals would have provided interesting information as to the extent of the tensile membrane at the time of initial failure. The large values that these attained would have made their measurement easier.

(xiv) The interaction of the different elements of

the floor was particularly noticeable in this case - an example of the value of testing structural systems rather than separate elements.

CHAPTER 11

A COMPARISON OF THE REINFORCING STEEL REQUIREMENTS OF THE MODEL FLOOR, DESIGNED WITH AND WITHOUT ALLOWANCE FOR MEMBRANE ACTION

11.1 INTRODUCTION AND SUMMARY

When compared with normal design procedure, the method of design used for the model floor resulted in a saving of panel reinforcement but an increased amount of steel in the beams. In view of the satisfactory behaviour of the model floor it is of interest to compare the actual amounts of steel involved and to determine whether a net loss or gain results. Such an analysis was performed using straightforward procedures to calculate the steel volumes required. The analysis showed that for the model floor, approximately 7 per cent extra steel was required for membrane action design.

However, in cases where the beam steel for earthquake moments (EQ + DL + Seismic LL) exceeded that required for full service load moments (DL + LL) plus tension induced by membrane action, a saving of total steel could be made by allowing for membrane action in the design of the panels. It was concluded that when earthquake moments governed the

strength of the beams, design of the panels for a service load of DL + $\frac{2}{3}$LL (without allowance for membrane action) could be considered.

11.2 GENERAL BASIS OF COMPARISON

In calculating the volume of longitudinal steel in the beams, the area of steel at any section of the beam was found by linear interpolation between the critical points (see Figure 11.1). No allowance was made for anchorage length or for standard bar sizes.

One quarter of the positive steel was continued to the support unless a greater amount was required for torsion. One third of the negative steel was extended a distance of one tenth of the span past the point of inflexion. The additional steel required for beam tension was calculated from the difference between steel areas at the critical sections with and without tension. The extra volume is represented by the shaded areas on Figure 11.1.

The volume of shear and torsion steel stirrups was calculated according to the actual area of the shear force and torsion diagrams. No extra torsion steel was required for membrane action design but extra shear steel was required because, when the beams were required to carry tension, the shear force carried by the concrete was assumed to be zero.

Panel steel was calculated from the lengths actually

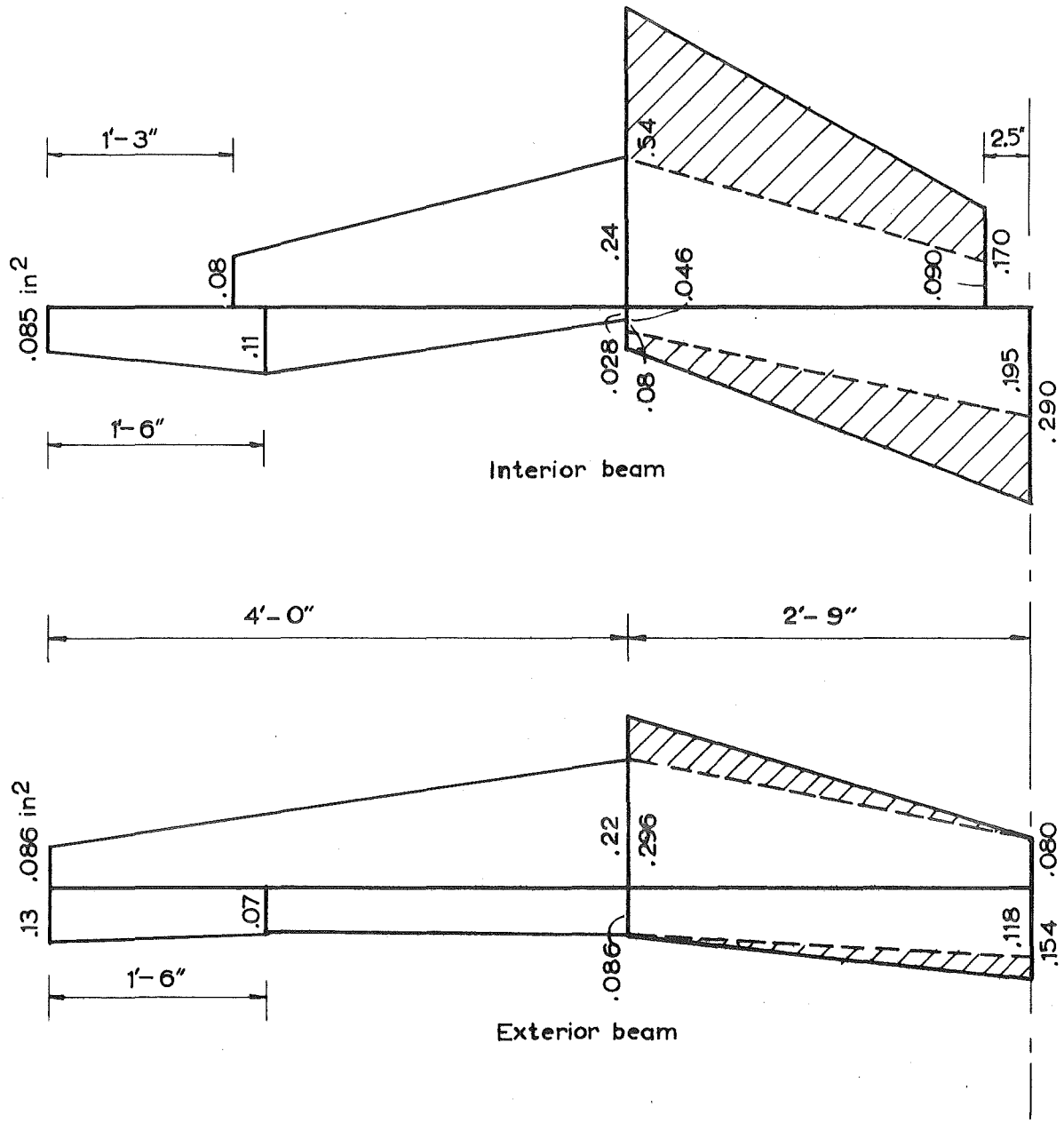


FIGURE 11.1 LONGITUDINAL STEEL IN BEAMS

used. For design with no membrane action the volume of steel in the slab was taken as the volume allocated for the membrane action design multiplied by the enhancement factor appropriate to the panel.

11.3 COMPARISON OF STEEL VOLUMES

11.3.1 Panel Steel

(a) Bottom steel as placed:

35 lengths of $\frac{1}{8}$" diameter each way, 13.79 ft. long

Volume = 142.2 in^3

(b) Top steel as placed: (5" off each end for anchorage)

80 lengths of $\frac{1}{8}$" diameter each way x 19.5"

80 " " " " " " x 11.0"

Volume = 57.8 in^3

Distribution between the panels was the same for top and bottom steel as follows:

Centre panel	.165	times total area
4 Rectangular panels	.485	" " "
4 Corner panels	.350	" " "
	1.000	

Without membrane action, panel steel volumes were increased according to the enhancement factors, viz., 1.00 for the corner panels, 1.35 for the rectangular panels and 1.97 for the centre panel.

Table 11.1 summarises the results of the panel steel comparison.

Table 11.1. Panel Steel Volume Comparison.

	Panel(s)			
	Centre	Rectangular (4)	Corner (4)	All
Membrane Action Design:				
Top	9.5	28.1	20.2	57.8
Bottom	23.5	69.0	49.7	142.2
Total	33.0	97.1	69.9	200.0
Conventional Yield Line Theory Design:				
Top	18.7	38.0	20.2	76.9
Bottom	46.3	93.0	49.7	189.0
Total	65.0	131.0	69.9	265.9
Difference:				
Top	9.2	9.9	-	19.1
Bottom	22.8	24.0	-	46.8
Total	32.0	33.9	-	65.9

All volumes in cubic inches.

11.3.2 Overall Comparison

The volumes of longitudinal beam steel were calculated from the areas shown in Figure 11.1.

The total volume of shear steel in the beams was assumed to be proportional to the total area of the shear force diagram, less the area represented by the shear taken by the concrete. Similarly the total volume of torsion stirrups was assumed to be proportional to the net area of the torsion diagram.

The results of calculations of beam and slab steel volumes are given in Table 11.2.

Table 11.2. Steel Volume Comparison - All Elements.

Element	Steel Volume (in^3)			Per Cent Saving
	Membrane Action Design	Y.L.T. Design	Difference	
SLAB				
Centre Panel	33.0	65.0	32.0	49.3
4 Rect. Panels	97.1	131.0	33.9	25.9
4 Corner Panels	69.9	69.9	0.0	0.0
All Panels	200.0	265.9	65.9	24.8
EXTERIOR BEAMS				
Long. Steel	171.8	153.9	-17.9	-11.3
Shear Steel	24.8	16.8	-8.0	-47.7
Torsion Steel	56.0	56.0	0.0	0.0
EXT. BEAM TOTAL	252.6	226.7	-25.9	-11.3
INT. BEAMS				
Long. Steel	213.6	146.6	-67.0	-45.8
Shear Steel	40.6	20.4	-20.2	-99.1
Torsion Steel	0.0	0.0	0.0	0.0
INT. BEAM TOTAL	245.2	167.0	-87.2	-52.2
BEAM TOTAL	506.8	393.7	-113.1	-28.8
FLOOR TOTAL	706.8	659.6	47.2	-7.2

11.4 DISCUSSION

The figures of Table 11.2 show that for the membrane action design the volume of the additional steel required in the beams exceeded the volume of steel saved in the

panels and that the net difference was 7.2 per cent of the total steel volume which would have been required for normal yield line theory design. Before conclusions can be drawn from these figures several aspects require discussion.

(a) Method of Steel Volume Calculation

The method of longitudinal steel volume calculation represents a compromise between the exact following of bending moment, tension, and torsion variation, and the restraints imposed by practical considerations. The method used for shear and torsional stirrup requirements, in following exactly the variation of shear force and torsion, took no account of minimum steel requirements of codes of practice. There was therefore a tendency to underestimate the total stirrup steel volume and to overestimate the additional steel required when tension was present.

(b) Adequacy of Design Assumptions

The volume of steel required for membrane action design was computed on the basis of the steel used in the model floor. High steel strains in both interior and exterior beams confirmed that the longitudinal steel placed was not excessive. However the beams did not show signs of failure at any stage and a small percentage of this steel could have been unnecessary. The same may be said of the stirrups. No strain measurements were taken

on this steel and the degree of excess was difficult to determine.

It is reasonable to conclude that a small amount of the steel placed in the beams was unnecessary and that the net loss would be no greater than the 7.2 per cent quoted in Table 11.2.

(c) Dual Use of Beam Steel Required for Earthquake Actions

The model floor was typical of a floor in a multi-storey reinforced concrete frame building but the beams were designed for vertical loads only. In earthquake-prone areas, beams supporting a typical floor of a multi-storey frame building would be required to resist considerable earthquake moments. The steel placed to counter these moments could well be more than is required to resist the moments and tensions due to vertical loads alone. Two principal reasons exist for this. Firstly, the earthquake moments in the beams may act in either direction requiring additional steel at the bottom of the support sections. The second factor is the allowable reduction in live load when earthquake forces are considered. NZSS 1900 Chapter 8[36] allows design for the combination of earthquake forces and the vertical loads to be for a load of

Dead load + $\frac{1}{3}$ live load + earthquake

(DL + $\frac{1}{3}$ LL + EQ)

for buildings with relatively low live loads and

$$DL + \tfrac{2}{3} LL + EQ$$

for high live loads.

Thus, when earthquake beam moments are relatively high, it may be possible to design some interior floor panels by ordinary yield line theory for a load of DL + $\frac{1}{3}$ LL or DL + $\frac{2}{3}$ LL having ensured that when vertical load only is considered:

(i) Membrane action in the panels will provide sufficient assistance to carry the balance of live load.

(ii) The beam steel required for the full live load condition does not exceed that required for DL + part LL + EQ.

Condition (i) will be satisfied if the surrounding panels provide sufficient lateral stiffness, and if the beam steel is sufficient to carry the tension induced by the membrane action. Satisfaction of condition (ii) will depend upon the relative magnitudes of earthquake and full live load moments.

For the steel areas involved in the model slab, the ratio (M_{EQ}/M_{DL+LL}) was determined for which, at the support section of the beams:

(Steel for DL + part LL + EQ) = (Steel for DL + LL)

The method by which comparison was made is described below.

Let A = total area of steel at section for moment and

tension at DL + LL.

A_m = that part of A required for moment only.

$A_t = A - A_m$ = extra steel required for tension

F = ratio of panel ultimate load to Johansen load.

v = the proportion of live load considered to act concurrently with horizontal earthquake loads.

The moment acting on the section is directly proportional to the load and the following assumptions were made in determining the steel areas:

(a) A_m was directly proportional to moment. This is true to a first approximation since the distance between the lines of action of the steel and concrete forces in the section is relatively insensitive to change in moment. In fact, an increase in moment will cause a reduction in this distance and the actual amount of steel will be slightly more than assumed here.

(b) A_t was directly proportional to tension (c.f. Figure 4.3 (b)).

(c) Tension was directly proportional to the amount by which the applied vertical loading exceeded the Johansen load. This implies that compressive membrane action in the panels commences when the Johansen load is reached, which, although open to question is reasonable in this context.

(d) The tension induced in the centre spans of beams at the ultimate load was 5.2^K for the exterior beams and 17.6^K for the interior beams. It was assumed that 5.2^K of

the 17.6^K was due to the compression in the centre-edge panel.

Calculation of M_{EQ}/M_{DL+LL}(=Z) for the Interior Beam for $v = \frac{2}{3}$

At the support: $A = .54\ in^2$; $A_m = .24\ in^2$; $A_t = .30\ in^2 = 1.25\ A_m$. In this case DL = 100 psf, LL = 300 psf., ultimate load = 800 psf. Johansen load of centre-edge panel = 800 ÷ 1.35 = 594 psf. Johansen load of centre panel = 800 ÷ 2.0 = 400 psf. DL + $\frac{2}{3}$LL = 300 psf which requires design for an ultimate load of 300 x 2.0 = 600 psf.

By assumption (c) there is no membrane action in the centre-edge panel at this load and from assumption (d) the tension in the interior beam will be reduced by 5.2^K.

Membrane action in the centre panel will be reduced to (600-400)/(800-400) = $\frac{1}{2}$ of its full load value. The contribution of the centre panel to the interior beam tension at full load is, by assumption (d), = $17.6^K - 5.2^K = 12.4^K$. Therefore the tension must be reduced by half of this = 6.2^K. Thus the tension in the beam at 600 psf is assumed to be

$$T = 17.6^K - 5.2^K - 6.2^K = \underline{6.2^K}.$$

Using assumption (b) it is found that the area of steel required for this tension is $(6.2/17.6)A_t = .35A_t = .44A_m$. The steel required for moment will be (600/800) $A_m = .75A_m$

and the steel required for earthquake moment only is equal to

$$A_m \left(M_{EQ}/M_{DL+LL}\right) = A_m \cdot Z$$

The total steel required for DL + $\frac{2}{3}$LL + EQ will thus be

$$A_m \left(.44 + .75 + Z\right)$$

whereas for DL + LL the total required is A_m (1+1.25) = $2.25A_m$.

Hence for earthquake conditions to govern:

$$1.19 + Z > 2.25 \text{ or } Z > 1.06.$$

Conditions for this case and the others were:

DL + $\frac{2}{3}$LL	Interior Beam:	$Z > 1.06$
	Exterior Beam:	$Z > .72$
DL + $\frac{1}{3}$LL	Interior Beam:	$Z > 1.75$
	Exterior Beam:	$Z > .97$

It is important to note that whereas the DL + $\frac{2}{3}$LL condition required extra tension steel, the DL + $\frac{1}{3}$LL condition did not.

However, any disadvantage in the former case is offset by the presence of earthquake steel required for the reversal of loading which was not included in the above analysis. Since the values of Z shown above are frequently exceeded in practice, it would be possible in many cases to design the panels by normal yield line theory to sustain substantially less than the full live load.

Such a design procedure would require careful

consideration of the conditions of lateral restraint at the edges of the panels which would make the method less attractive. But the above analysis indicates that existing floors satisfying the necessary conditions for membrane action would have a considerable reserve of strength.

11.5 CONCLUSIONS

The preceding analysis has shown that membrane action design requires more steel to be placed in the supporting beams than could normally be saved in the panels.

In situations in which beam steel is required for other loads such as earthquake loading, a net saving of steel could be achieved.

Floors in which this saving could be made would have to:

(i) Be required to sustain live loads high enough for minimum steel requirements not to govern the determination of panel steel.

(ii) Be part of relatively tall frame buildings in which earthquake moments are high.

(iii) Contain panels whose edges meet a high degree of restraint against lateral movement.

An important corollary to the conclusions above refers to panels of multi-panel slab and beam floors in which the beams have been designed to resist earthquake moments, viz., many of these panels, even when designed by yield

line theory, will be capable of carrying loads which are very much greater than those for which they have been designed. Furthermore, this will apply to cases in which adjacent panels of the floor are loaded simultaneously, provided the supporting columns are not overloaded.

CHAPTER 12

GENERAL CONCLUSIONS

12.1 CONCLUSIONS FROM WORK PERFORMED

Conclusions have been drawn at the end of each section, some of which are included in the following general conclusions.

(a) Concrete slabs reinforced with the minimum of steel required by Codes of Practice can sustain high loads without assistance from compressive membrane action. The benefits of enhancement of load due to membrane action will therefore be of greatest significance for slabs which are required to carry high loads.

(b) For a rectangular, orthotropically reinforced slab with equal hogging moments along opposite edges, a ratio of hogging to sagging moment in each direction equal to 2.0 gives the least volume of slab steel. Negative moment steel should extend into the slab for a fraction, λ, of the span from each edge such that $2\lambda = 1 - \frac{1}{\sqrt{1+i}}$, where i is the ratio of hogging yield moment to sagging yield moment in that direction. This length of top steel results in identical collapse loads for all four symmetrical yield line patterns for the panel.

(c) The assumption of rigid-plastic materials in the analysis of a clamped circular slab with its edges restrained elastically against outward movement is not accurate when the edge restraint is small. For very stiff surrounds the assumption is sufficiently accurate to compare well with experimental results.

(d) The absence of top steel at the edges of laterally restrained slabs has little effect on the ultimate load. The complete omission of top steel may not be wise but its length could be reduced in slabs subject to compressive membrane forces.

(e) Assessment of the effective surround movement should include the effects of slab shortening, creep and shrinkage. As the flexibility of the surround increases, it becomes increasingly important to account for vertical slab deformations occurring prior to the full development of yield lines.

(f) When compressive membrane action is exhibited in two adjacent panels of a slab and beam floor system, the common supporting beam must be designed to accommodate the tension induced. Design of the critical sections of such a beam may be performed using the ultimate strength method and limit analysis. It is recommended that in these cases moment redistribution should be kept to a minimum to guard against the adverse effects of beam deformation on the development of compressive membrane action in the panels.

(g) Extra longitudinal beam steel is required in beams which are designed for tension as well as flexure. However, the extra steel required is less than would be required for a pure tie of the same length as the beam.

(h) Membrane forces in slab panels can have an appreciable effect on the torsional moments induced in the beams supporting them.

(i) The outward deformations of the sides of a square surround of elastic material subject to in-plane loads can be closely approximated to those of an equivalent deep beam. Such a simplification would greatly assist in the development of a theory for membrane action which takes into account the interaction between membrane forces and surround movement.

(j) The theory due to Park proved satisfactory in designing a nine-panel model floor. High margins of safety were required when the outward movements of the surrounding panels were calculated on the basis of an elastic, uncracked surround.

(k) Failure of the centre panel of the model floor took place at a higher deflection than the 0.5D used in Park's theory and although membrane forces at the edge were of the same order as predicted by the theory, the tensile membrane stage had commenced before failure occurred.

(l) The extra steel added to the beams of the model floor to take the tension induced was no more than sufficient,

indicating that the beams must be designed to resist the tension induced and that the magnitude of the tensions was satisfactorily predicted and designed for in this case.

(m) Strain gauge measurements on the steel and concrete afforded a successful means of measuring compressive membrane forces in the panels and the tensile forces in the beam sections.

(n) The serviceability of the model floor designed by membrane action theory met code requirements as to deflections and crack widths at service load. The stability of the central panel under sustained service loading was encouraging, especially in view of the high span to depth ratio of 32. More knowledge of the effect of long term loading on restrained slabs in practical situations is required before confident predictions of the long term behaviour of such slabs can be made.

(o) Consideration of membrane action in the design of the nine-panel model floor resulted in a considerable saving of slab steel but the extra beam steel required for tension exceeded that saved in the panels. In favourable circumstances, however, a net saving of steel could be achieved by using the beam steel provided for earthquake moments to carry the tension induced.

(p) When design for earthquake allows a reduction in live load, the steel required for earthquake moments in the beams can be used to carry the tension induced by panel

membrane action. The panels could be designed for reduced live load by yield line theory provided the capacity of membrane action to take the balance is ensured.

12.2 SUGGESTIONS FOR FURTHER RESEARCH

An additional margin for safety exists in panels, designed by yield line theory, but having boundary conditions conducive to the development of membrane action. This additional capacity may be utilised by permitting floors to be loaded in excess of the design live load in favourable circumstances.

However, the design of such panels to allow for membrane action is another matter, requiring a reliable and accurate means of assessing the enhancement that membrane action will produce. Although the ultimate load of the central panel of the nine-panel model floor described in Chapter 9 was accurately predicted by an existing theory for membrane action, more research would be required before a reliable design method could be derived. Existing slab theories and methods of analysis which have been developed principally for slabs with high lateral restraint allow quite accurate prediction of the behaviour of such slabs. But in floor slabs where only moderate lateral restraint exists, these methods cannot be regarded as reliable.

In the case of floor panels in buildings, extremely high design loads would be required before the benefits of

membrane action could be fully exploited. In floors where the enhancement by membrane action could be used, it appears that the overall economic advantages would not be great. The development of a reliable design procedure for slab and beam floors would require:

(i) The development of a theory which accounts for the interaction of membrane forces along the boundary of the slab and the outward movement of the restraining medium. This in itself would not be sufficient because the increasing deflection at ultimate load with decrease in surround stiffness would have to be recognised. In particular, future theories should recognise the tendency for a tensile membrane region to form at the middle of the slab before the ultimate load is reached.

Extension of Park's theory[11] using a more refined strip approximation, possibly using the results of Gurfinkel[16], could provide a solution, but the assumption that the membrane force is constant along each strip would require close examination.

(ii) Further investigation of the effects of tension on the behaviour of beams, particularly as to the flexural and shear reinforcement requirements. In cases where the beams provide much of the lateral restraint, knowledge of the effect of tension on the axial stretch would be valuable.

(iii) Experimental studies of the effects of long

term loading of slabs with surrounds of reinforced concrete. These would do much to remove the uncertainty inherent in the sensitivity of membrane action to loss in lateral stiffness.

This work would probably not be warranted in the case of floors where lateral restraint at the edges is usually low and the design loads insufficiently high. For structures such as pressure vessels and blast resistant structures, where the surround stiffness is high, the rigid-plastic theories incorporating an allowance for edge movement (e.g., the theory due to Park) will give satisfactory results, but research on (i) and (ii) above could provide useful improvements for this situation.

The study of the effects of panel membrane action on other parts of the structure is important whether or not the enhancement of the panel is allowed for in design. Further research, particularly experimental, on the effects of membrane action on the torsion induced in the supporting beams could lead to less stringent design requirements for torsion in edge beams in some cases.

This points to the need for further studies of whole structural systems. Tests on separate structural elements have the advantage that the actions applied to the element may be accurately determined because forces due to the interaction of elements may be eliminated. Membrane action is a very good example of a case in which these

interaction effects are beneficial to a degree which is worth considering in design, even if very high safety margins must be imposed.

In studies of whole structural systems it is not sufficient to rely on the equality of steel tension and concrete compression in a beam or slab section and greater importance must therefore be placed on the role of the concrete strain gauges. Further research into the measurement of actions on a reinforced concrete section would be valuable in providing a reliable means of interpreting the experimental data obtained.

APPENDIX A - DESIGN CALCULATIONS

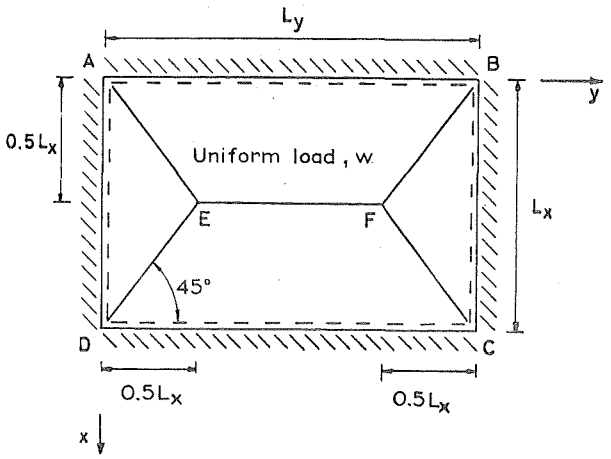
A.1 PARK'S EQUATIONS FOR THE ULTIMATE LOADS OF PANELS

For the design of the centre and centre-edge panels of the nine-panel model floor, the equations derived by Park[11] were used to estimate the contribution of compressive membrane action to their load carrying capacities.

The equations were derived using the approximate yield line pattern of Figure A.1(a). The slab was envisaged as a series of strips in each direction and the sum of axial, creep and shrinkage strains, ϵ, and the outward boundary movement, t, was the same for all strips in the same direction. Conditions of geometrical compatibility and equilibrium of horizontal forces were used to obtain the actions at the critical sections of each strip (see Figures A.1(b), (c), (d)).

Analysis by virtual work for a slab with all edges restrained and with an empirical value of 0.5D for the central deflection at the ultimate load gave

$$\frac{wL_x^2}{24}\left(3\frac{L_y}{L_x}-1\right) = k_1k_3uD^2\left\{\frac{L_y}{L_x}(\cdot188-\cdot281k_2)+(\cdot479-\cdot490k_2)\right.$$
$$+\frac{\epsilon'_x}{16}\left(\frac{L_x}{D}\right)^2\left[2\frac{L_y}{L_x}(3k_2-1)+k_2-1\right]+\frac{\epsilon'_y}{16}\left(\frac{L_x}{D}\right)^2\frac{L_y}{L_x}(7k_2-3)-\frac{k_2}{8}\frac{L_y}{L_x}\left(\frac{L_x}{D}\right)^4\left[\epsilon'^2_x+\frac{L_y}{L_x}\epsilon'^2_y\right]\Bigg\}$$
$$-\frac{k_2}{2k_1k_3u}\left\{\frac{L_y}{L_x}\left(T'_x-T_x-C'_{sx}+C_{sx}\right)^2+\left(T'_y-T_y-C'_{sy}+C_{sy}\right)^2\right\}$$
$$+C_{sx}\left\{\frac{L_y}{L_x}\left(\frac{D}{4}-d_{2x}\right)+\frac{D}{8}\right\}+C'_{sx}\left\{\frac{L_y}{L_x}\left(\frac{D}{4}-d'_{2x}\right)+\frac{D}{8}\right\}+T_x\left\{\frac{L_y}{L_x}\left(d_{1x}-\frac{D}{4}\right)-\frac{D}{8}\right\}$$
$$+T'_x\left\{\frac{L_y}{L_x}\left(d'_{1x}-\frac{D}{4}\right)-\frac{D}{8}\right\}+C_{sy}\left(\frac{3D}{8}-d_{2y}\right)+C'_{sy}\left(\frac{3D}{8}-d'_{2y}\right)$$
$$+T_y\left(d_{1y}-\frac{3D}{8}\right)+T'_y\left(d'_{1y}-\frac{3D}{8}\right) \qquad \ldots.(A.1)$$

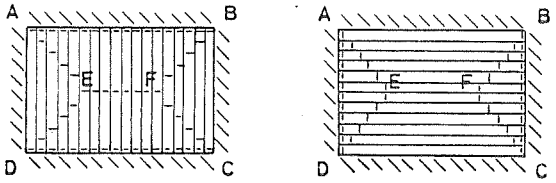


— — Hogging moment yield line

——— Sagging moment yield line

\\\\\ Fully fixed edge

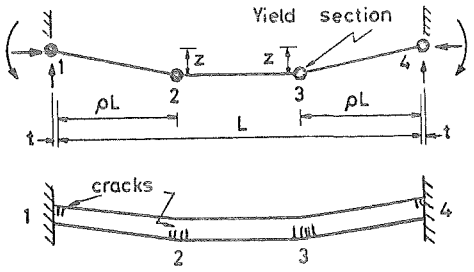
ASSUMED YIELD LINE PATTERN



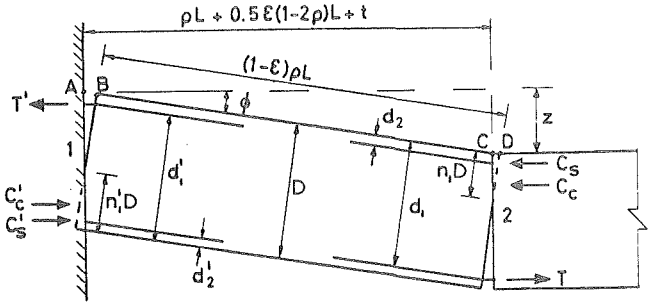
or - Yield sections

STRIPS OF EQUIVALENT SLAB

(a) UNIFORMLY LOADED TWO-WAY SLAB WITH ALL EDGES FULLY FIXED

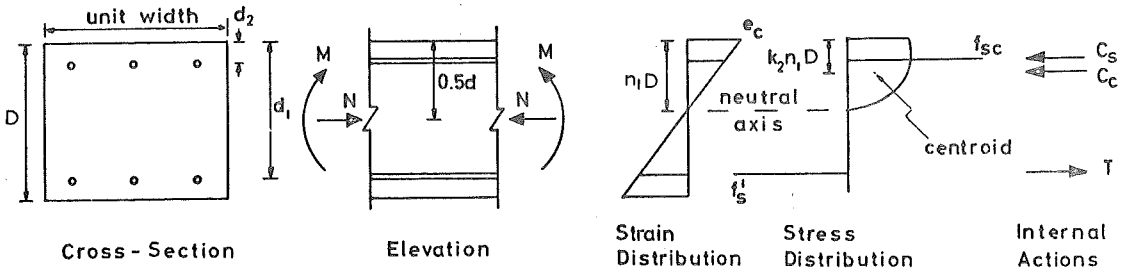


(b) COLLAPSE MECHANISM OF A STRIP.



(c) INTERNAL ACTIONS AT YIELD SECTIONS OF END PORTION OF STRIP.

FIG. 2



(d) CONDITIONS AT A SECTION ON A YIELD LINE WITH SAGGING MOMENT.

FIGURE A.1 STRIP APPROXIMATION IN THEORY DUE TO PARK

In which subscripts x and y denote values in the x and y directions and $\epsilon'_x = \epsilon_x + \frac{2t_x}{L_x}$, $\epsilon'_y = \epsilon_y + \frac{2t_y}{L_y}$.

At this load, w, the mean values of the membrane forces in each direction were given by:

$$\text{Mean } N_y = k_1 k_3 u D\left[\frac{7}{16} - \frac{\epsilon'_y}{4}\frac{L_y}{L_x}\left(\frac{L_x}{D}\right)^2\right]$$

$$+\frac{1}{2}\left(C'_{sy} + C_{sy} - T'_y - T_y\right) \qquad \ldots.(A.2)$$

$$\text{Mean } N_x = k_1 k_3 u D\left[\frac{3}{8} + \frac{1}{16}\frac{L_x}{L_y} - \frac{\epsilon'_x}{4}\left(\frac{L_x}{D}\right)^2\right]$$

$$+\frac{1}{2}\left(C'_{sx} + C_{sx} - T'_x - T_x\right) \qquad \ldots.(A.3)$$

When only three edges were restrained, membrane action was considered to act only in the strips between opposite restrained edges. For a long edge (L_y direction) unrestrained laterally but restrained against rotation, the ultimate load, w, was given by

$$\frac{w L_x^2}{24}\left(3\frac{L_y}{L_x} - 1\right) = k_1 k_3 u D^2 \left\{ .363 - .406 k_2 + \epsilon'_y \left(\frac{L_x}{D}\right)^2 \frac{L_y}{L_x}\left(.562 k_2 - .25\right) \right.$$

$$- .195 \epsilon'^2_y k_2 \left(\frac{L_y}{L_x}\right)^2 \left(\frac{L_x}{D}\right)^4 + C'_{sy}\left(.4D - d'_{2y}\right) + C_{sy}\left(.4D - d_{2y}\right) + T'_y\left(d'_{1y} - .4D\right)$$

$$+ T_y\left(d_{1y} - .4D\right) - \frac{k_2}{2k_1 k_3 u}\left(T'_y - T_y - C'_{sy} + C_{sy}\right)^2$$

$$\left. + \frac{L_y}{L_x}\left\{ T'_x\left(d'_{1x} - \frac{k_2 T'_x}{k_1 k_3 u}\right) + T'_x\left(d_{1x} - \frac{k_2 T_x}{k_1 k_3 u}\right)\right\}\right. \qquad \ldots.(A.4)$$

and the mean membrane force was given by:

$$\text{Mean } N_y = k_1 k_3 u D \left\{ .4 + .05 \frac{L_x}{L_y} - .312 \epsilon'_x \left(\frac{L_x}{D}\right)^2 \right\}$$

$$+ \tfrac{1}{2}\left(C'_{sx} + C_{sx} - T'_x - T_x \right) \qquad \ldots.(A.5)$$

A.2 DESIGN OF PANELS

A.2.1 Slab Thickness

Placement of minimum reinforcement at maximum spacing imposed the following conditions when the British Code[35] was used:

$$A_s \geq .0015 \; s \; D \qquad \ldots.(A.6)$$

and

$$s \leq 3d \qquad \ldots.(A.7)$$

With two layers of steel of $\frac{1}{8}$" diameter and minimum cover = 3/16", the mean effective depth of the centroid of the two layers of steel was

$$d = D - 5/16" \qquad \ldots.(A.8)$$

Since A_s was known, Equations A.6, A.7, A.8 could be solved for s, D and d. Solution gave D = 1.81 in. but a value of 1.94" was finally set to give a smaller span to depth ratio to assist in the development of compressive membrane action. This gave d from Equation A.8 as 1.62" which led to a

spacing of 4.25" when Equation A.6 was applied.

A.2.2 Determination of Panel Size and Negative Reinforcement

(a) Centre Panel

The Johansen load, w_J, of the panel was to be w ÷ 2 = 400 psf.

The panel was to be square and symmetrical and hence $m_x = m_y$, $m'_x = m'_y$, $i_x = i_y$, $L_x = L_y$. When a reduction of 8 per cent for corner effects (see Wood[7], p. 66) is applied, yield line theory gives

$$w_J = \frac{22.1\ m_x(1 + i_x)}{L_x^2} \qquad \ldots.(A.9)$$

With $\frac{1}{8}$" bars of yield force 640 lb. at 4.25 inch spacing the sagging yield moment is given by ACI 318, Equation 16.1:

$$m_x = \phi\ A_s f_y(d - a/2) \qquad \ldots.(A.10)$$

where ϕ = 1.0 in this case, $A_s f_y = \frac{640\ \text{lb.}}{.85 f'_c b}$ (b = 4.25")

Therefore m_x = 241 lb.in/in

Substituting m_x = 241 lb.in/in, w_J = 400/144 in Equation A.9 gives

$$L_x^2 = 1915\ (1 + i_x) \qquad \ldots.(A.11)$$

Several trials were made before values of L_x = 62.5", i_x = 1.07 were chosen.

(b) Corner Panels

Since hogging yield moments were to be fully developed along all four edges of these square panels, yield line analysis was identical to that of the centre panel. In this case membrane action was assumed to provide no enhancement of load-carrying capacity and $w_J = w = 800$ psf.

Both top and bottom reinforcing were to be the same as in the centre panels so that from Equation A.9, L_x = 44.5".

(c) Centre-edge Panels

For these panels, then, $L_x = 44.5$ in. $L_y = 62.5$ in. The same reinforcement as in the other panels was to be placed. The quantities $m_x = m_y$, $i_x = i_y$ etc., had the same average values as in the square panels. Equation 2.3, for the collapse load of a rectangular slab, restrained at its edges with allowance for an eight per cent reduction for corner effects and with L_y/L_x = 2 then gave w_J = 594 psf indicating a required enhancement factor of 1.35.

A.2.3 Computation of Maximum Allowable Lateral Spread

(a) Centre Panel

The values of d'_x (= d'_y) which gave an ultimate load of 800 psf were determined directly from Equation A.1 in which D = 1.94 in., L_x = 62.5 in., L_y/L_x = 1.0, w = 6.05 psi (increased by eight per cent for corner effects), u = 5250 psi, L_x/D = 32.2, mean d' = 1.62 in., T_x = 154 lb/in

T'_x = 164 lb/in.

For u = 5250, k_2 = .445, k_1k_3 = .575. Substitution of the above quantities in Equation A.1, neglecting the effects of compression steel, gave

$$\epsilon'_x = \epsilon'_y = 13.6 \times 10^{-4}$$

The minimum value of ϵ'_x to make the neutral axis depth zero as given by Park[11] is

$$\epsilon'_x = 1.5\left(\frac{D}{L_x}\right)^2 = 14.5 \times 10^{-4}$$

indicating that the neutral axis depth would not reduce to zero at failure.

Substitution of $\epsilon'_x = 13.6 \times 10^{-4}$ into Equation A.2 gave

Mean N_y = 340 lb/in.

(b) Centre-edge Panel

In this case: L_x = 44.5 in., L_y = 62.5 in., L_y/L_x = 1.41, w = 6.05 psi., u = 5250 psi., k_2 = .445, k_1k_3 = .575, L_x/D = 22.9. T'_x = 164 lb/in., T_x = 154 lb/in., T'_y = 172 lb/in., T_y = 144 lb/in.

Again ignoring the effects of compression reinforcement forces, substitution in Equation A.4 gave

$$\epsilon' = 16.3 \times 10^{-4}$$

The limiting value for the use of Equation A.4 given by Park is

$$\epsilon'_y = 1.75 \left(\frac{D}{L_x}\right)^2 L_x/L_y = 23.6 \times 10^{-4}$$

Substitution of $\epsilon'_y = 16.3 \times 10^{-4}$ in Equation A.5 gave Mean $N_y = 270$ lb/in.

A.2.4 Beam Tensions

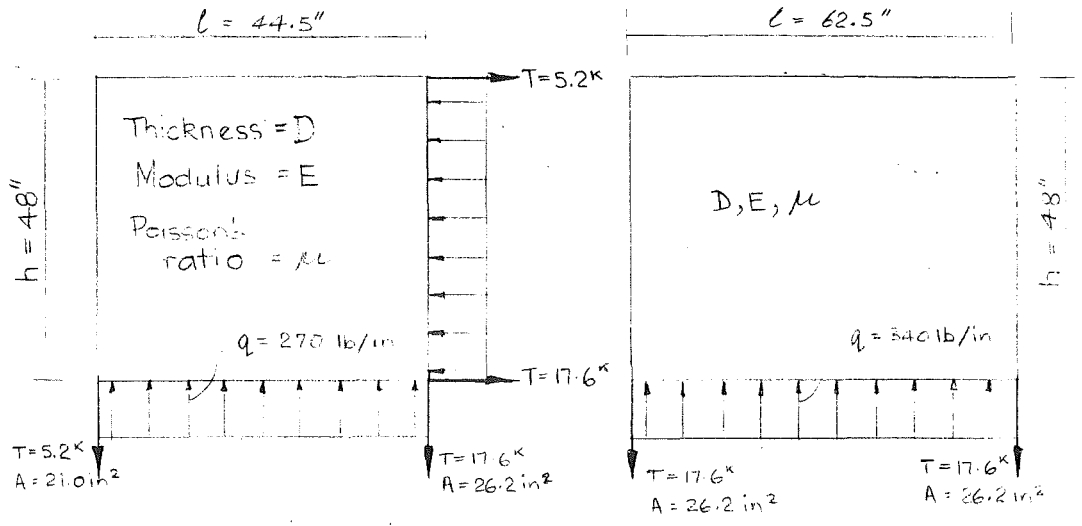
Only the centre spans of the beams had tension induced in them as may be seen in Figure 6.3(a). The outer line of panels was considered as a deep beam of uniform flexural stiffness to give tensions of 5.2^K in the exterior beams and 17.6^K in the interior beams.

A.2.5 Outward Movement of Surround

(a) Axial strain in beams was calculated assuming an uncracked concrete section of area, A, and modulus of elasticity, E. The contribution of this axial stretch to ϵ'_x in Equations A.1 to A.5 was:

$$\epsilon'_{at} = T/EA \qquad \ldots.(A.12)$$

(b) Bending and shear deformation of the surrounding panels was calculated assuming that each panel was a simply supported beam of uncracked concrete with properties as shown in Figure A.2.



(a) Corner Panel (b) Centre-edge Panel

FIGURE A.2. SURROUNDING PANELS AS DEEP BEAMS

Deflection due to bending was negligible compared with shear deformation which may be shown to have a maximum value of

$$\frac{5}{384}\frac{q\,l^4}{EI}\left(\frac{h}{l}\right)^2(1+\mu)(2.4) \qquad \ldots.(A.13)$$

The contribution to surround movement was assumed to be .75 of this and for $\mu = .15$, $E = 3 \times 10^6$ psi, the contribution to ϵ'_x was:

$$\epsilon'_s = 2.16 \times 10^{-8}\,\frac{q}{D}\,\frac{l}{h} \qquad \ldots.(A.14)$$

(c) The contribution of axial shortening of a typical slab strip to ϵ'_x was

$$\epsilon'_{ss} = (\text{Mean } N_y)/(D.E) \qquad \ldots.(A.15)$$

(d) The contribution of differential shrinkage to ϵ'_x

was assessed as follows: for a strip of concrete reinforced with a ratio, p, of reinforcement which has a modulus of elasticity equal to n times that of the concrete the restrained shrinkage strain, ϵ_r may be shown to be given by:

$$\epsilon_r = \epsilon_u/(1 + np) \qquad \ldots.(A.16)$$

in which ϵ_u is the shrinkage of an unrestrained strip which was assumed to be .001 (c.f. Figure 6.9). For n = 10, slab steel ratio = .0025, beam steel ratio = .02, the differential shrinkage strain from Equation A.16 was: $\epsilon'_{sh} = 1.5 \times 10^{-4}$.

The total surround movement, ϵ'_x, was assumed to be

$$\epsilon'_x = (E'_s + \epsilon'_{at} + \epsilon'_{ss})K_s K_c + \epsilon'_{sh}) \qquad \ldots.(A.17)$$

in which K_s was a constant expressing the effect of loss of surround stiffness due to cracking and flexural action of the beams and slabs and K_c was a factor expressing the effect of creep deformations.

A.2.6 Determination of $K_s K_c$

If the maximum allowable outward spread strain required by Park's equations is denoted ϵ'_{xp}, then from Equation A.17:

$$K_s K_c = (\epsilon'_p - \epsilon'_{sh})/(\epsilon'_s + E'_{at} + \epsilon'_{ss}) \qquad \ldots.(A.18)$$

Designs requiring $K_s K_c$ to be less than 4.0 were

modified and for the final design the following values resulted:

(i) Centre Panel (Figure A.2(b)):

Equations A.12 to A.16 with D = 1.94", A = 26.2 in^2, T = 17.6^K gave

$\epsilon'_s = .1 \times 10^{-4}$

$\epsilon'_{at} = 2.3 \times 10^{-4}$

$\epsilon'_{ss} = .6 \times 10^{-4}$

$\epsilon'_s+\epsilon'_{at}+\epsilon'_{ss} = 3.0 \times 10^{-4}$

$\epsilon'_{sh} = 1.50 \times 10^{-4}$

and with $\epsilon'_{xp} = 13.6 \times 10^{-4}$ Equation A.18 gave $K_sK_c = 4.0$.

(ii) Centre-edge Panel (Figure A.2(a)):

In this case $\epsilon'_s = .03 \times 10^{-4}$

$\epsilon'_{at} = .8 \times 10^{-4}$ - exterior beam

$\epsilon'_{at} = 2.3 \times 10^{-4}$ - interior beam

Average $\epsilon'_{at} = 1.6 \times 10^{-4}$

$\epsilon'_{ss} = .5 \times 10^{-4}$

$\epsilon'_s + \epsilon'_{at} + \epsilon'_{ss} = 2.1 \times 10^{-4}$

$\epsilon'_{sh} = = 1.5 \times 10^{-4}$ as before

With $\epsilon'_{xp} = 16.3 \times 10^{-4}$. Equation A.18 gave $K_sK_c = 7.0$

which could not be reduced without violating minimum reinforcement requirements imposed by CP114.

A.3 DESIGN OF BEAMS

A.3.1 Exterior Beams

(a) Design Actions

The critical cases of loading shown in Figure 6.4 (p. 107) gave rise to the design actions shown in Figure A.3. The moments and shears in the beam were calculated from the loading of Figure 6.4 on the assumption that the beam behaved elastically and had uniform flexural stiffness for its whole length.

The mid-point of each span was assumed to be a point of zero torque and the maximum effects at the supports were computed due to the action of the yield moment and eccentric vertical shear at the slab edge. For the end spans this gave the maximum torque, $M_{tmax} = \frac{1}{2}.L_x m'_x + (\frac{1}{8}.wL_x^2).\frac{b}{2}$ and for the centre spans:

$$M_{tmax} = \frac{1}{2}.L_y.m'_x + (\frac{1}{8}.wL_x^2 + \frac{1}{2}(L_y - L_x)).\frac{b}{2}.$$

The development of this torsion caused positive bending moments in the end spans of the adjacent beams at right angles.

(b) Size of Cross Section

On the basis of preliminary shear, torsional and flexural strength requirements a section 6" deep and

$3\frac{1}{2}$" wide was chosen. The limiting case for flange width as given by ACI 318-63 Clause 906(d) was 1/12 of the span or 4 in.

(c) Allocation of Shear and Torsion Steel

The Australian Code[33] gives the nominal concrete stress due to torsion as

$$f_t = \frac{3\ M_t}{b^2 d} \qquad \ldots.(A.19)$$

A rectangular section was taken in this case since the torsion was induced by yield moments which developed at the junction of the beam and slab.

For the middle span of the exterior beams the ratio of nominal torsional stress to nominal shear stress (ACI 318-63 Clause 1701) was approximately .7 : .3. This ratio was used in distributing the shear and torsion taken by uncracked concrete sections.

Maximum allowable nominal shear stress in concrete from ACI 318-63 Clause 1701 = $2\phi \sqrt{f'_c}$ = 135 psi (ϕ=.945)

Shear taken by concrete = 850 lb.

Force in two legs of stirrup = 1000 lb.

$V'_u.s$ for vertical stirrups = 6000 lb.in (ACI Equation 17-4)

$V'_u.s$ for 45° stirrups = 8500 lb.in (ACI Equation 17.6)

sM_t for vertical torsion stirrups = 12,700 lb.in^2 (Australian Code Equation (25) with yield stress

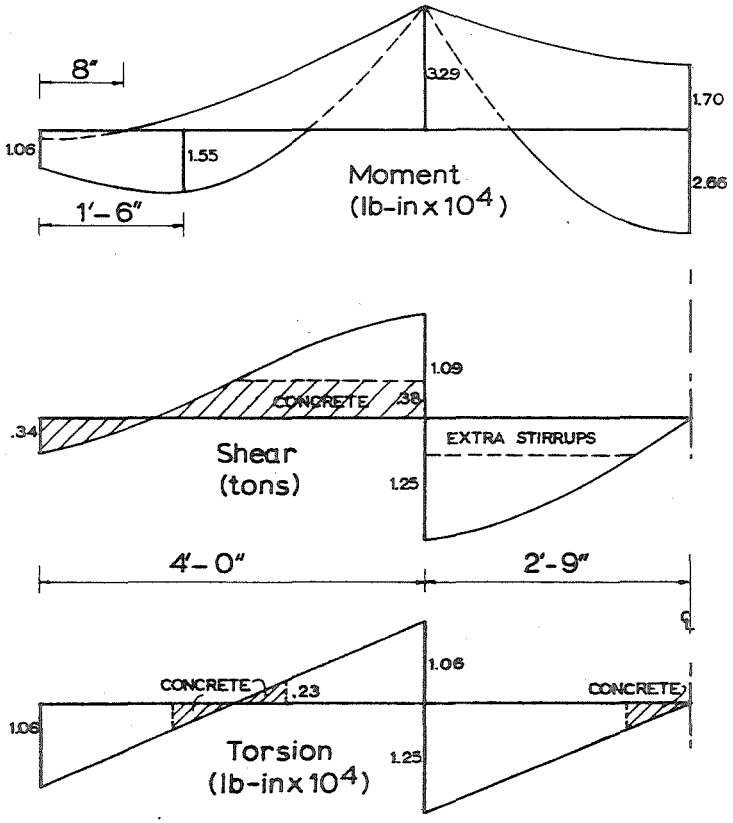


FIGURE A.3 EXTERIOR BEAM ACTIONS

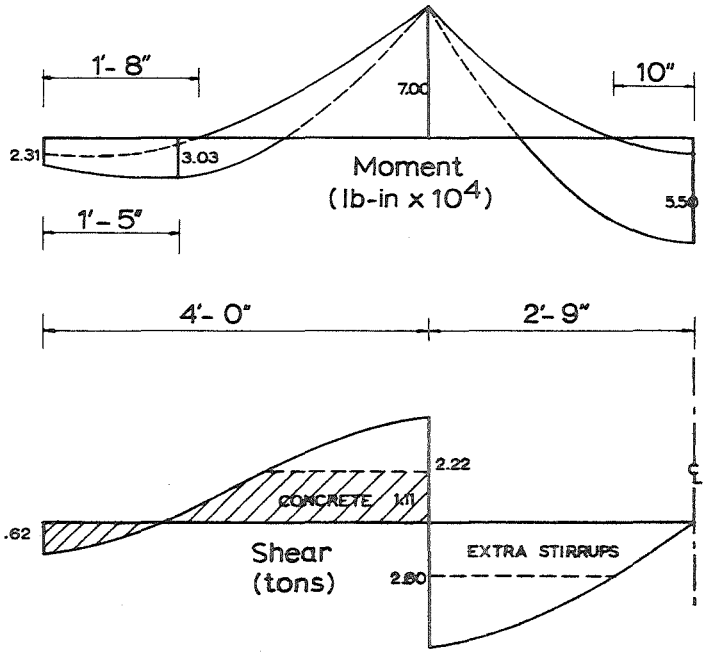


FIGURE A.4 INTERIOR BEAM ACTIONS

used in lieu of permissible stress)

Maximum torque in end spans = 10630 lb-in

Maximum torque in centre spans = 12500 lb-in

Minimum stirrup spacings: end spans: s_{min} = 1.2 in

centre spans: s_{min} = 1.0 in

Maximum longitudinal steel required for torsion (Equation 26 of Australian Code), A_{sh} = .172 in^2 for end spans, A_{sh} = .205 in^2

(d) Allocation of Flexural Steel

(i) In the centre span with tension:

In Equations 4.14 and 4.15: b = 3.5", b/b_f = .4, D = 6.0", f'_c = 4200 psi, f_y = 42000 psi,

At the support: $T/f'_c bd$ = .064, $M/f'_c bd^2$ = .089

Equation 4.14 gave p' = 1.28 per cent, A'_s = .25 in^2

Longitudinal torsional steel required at

top = .10 in^2

2 at $\frac{3}{8}$" dia. + 2 at $\frac{1}{4}$" dia. = .32 in^2

At mid-span: $M/f'_c bd^2$ = .044, $T/f'_c bd$ = .064

Equation 4.15 gave p = .85 per cent, A_s = .16 in^2

3 at $\frac{1}{4}$" dia. = .15 in^2

(ii) In the end spans (no tension):

At the support M = 3.29 x 10^4 lb", from ACI 318-63 Equation 16-1, A_s = .15 in^2

Torsional steel = .086 in^2

2 at $\frac{3}{8}$" dia. = .22 in^2

But the 2 - $\frac{1}{4}$" dia. bars on the other side of the support could not be curtailed and A_s supplied was .32 in^2

At the position of maximum positive moment

M = 1.55 x 10^4 lb-in, A_s = .07 in^2

2 at $\frac{1}{4}$" dia. = .10 in^2

A.3.2 Interior Beams

(a) Design Actions

Figure A.4 shows the design actions which were obtained as for the exterior beam except that the moment applied at the end due to edge beam torsion was the sum of the yield moments from the adjacent half span on each side of the beam.

(b) Size of Cross Section

This was set at 7.5" deep and 3.5" wide.

ACI Clause 906(b) imposed the condition that the maximum flange width should not exceed $\frac{1}{4}$ of the span which was therefore taken as 66÷4 = 16.5 in.

(c) Allocation of Shear Steel

Shear taken by concrete	= 2460 lb
Force in two legs of stirrup	= 1000 lb
$V_u'.s$ for vertical stirrups	= 7500 lb-in
$V_u'.s$ for 45° stirrups	= 10600 lb-in

(d) Allocation of Flexural Steel

(i) In the centre span with tension:

b = 3.5", D = 7.5", b/d_f = .2

At the support: $M/f_c'bd^2$ = .140, $T/f_c'bd$ = .171

Equation 4.14 gave p'=2.33 per cent, A'_s = .57 in^2

4 at $\frac{3}{8}$" dia. + 2 at $\frac{1}{4}$" dia. = .54 in^2

At mid-span: $M/f'_c bd^2$ = .034, $T/f'_c bd$ = .171

Equation 4.15 gave p = 1.30 per cent, A_x = .32 in^2

2 at $\frac{3}{8}$" dia. + 2 at $\frac{1}{4}$" dia. = .32 in^2

(ii) In the end span:

M = 7.00 x 10^4 lb-in, A_s = .24 in^2

2 at $\frac{3}{8}$" dia. = .22 in^2

However, on the other side 4 at $\frac{3}{8}$" + 2 at $\frac{1}{4}$" were provided and only 2 at $\frac{3}{8}$" were cut off so that A_s provided = .32 in^2.

At point of maximum positive moment:

M = 3.03 x 10^4 lb-in, A_s = .11 in^2

2 at $\frac{1}{4}$" dia. + 1 at $\frac{1}{8}$" dia. = .11 in^2

A.3.3 Graphical Allocation of Shear and Torsion Steel

The quantities $V'_u.s$ and $M_t.s$ for each stirrup represent an area on the shear force and torsion diagrams respectivly. Stirrup spacings were determined by dividing the areas into elements of area $V'_u s$ or $M_t.s$. For shear the total area covered was that representing the shear not taken by the concrete. For torsion the gross torsional moment was used after the total torque applied exceeded the torsional capacity of the uncracked concrete section.

Maximum spacings as governed by ACI 318-63 Clause 1706 (b) were 3.0 in for the exterior beams and 3.7 in for the interior beams.

Final steel placement is shown in Figure 6.1 (p. 96).

APPENDIX B - MATERIAL PROPERTIES AND SLAB DIMENSIONS

B.1 CONCRETE PROPERTIES

B.1.1 Details of Mix

Certified Concrete DD $\frac{1}{4}$" mortar mix.

Air	7 per cent
Slump	2"
Aggregate	8700 lb
Cement	1650 lb
Total water	1147 lb
Added water	720 lb

Water/cement ratio = .694

Aggregate grading:

Mesh	Weight	% Retained	Total Retained
3/16"	.06	6	6
7	.23	23	29
14	.19	19	48
25	.12	12	60
52	.12	12	72
100	.20	20	92
PAN	.08	8	100

B.1.2 Strength

The results of tests on standard control specimens were as follows:

(a) Cylinder Strength	Age When Tested (Days)	Number Tested	Ave. f'_c (psi)
	24	2	2775
	28	2	3850
	163	4	4350
	181	6	4350
	198	1	4420

(b) Cube Strength	Age	Number	Ave. u
	163	4	5310 psi
	181	5	4890 "
	198	3	4700 "

(c) Modulus of Rupture			
	163	3	710 psi
	181	4	680 "
	198	2	740 "

B.1.3 Modulus of Elasticity

Table B.1 gives a summary of readings taken on test specimens to determine the modulus of elasticity of the concrete used.

B.1.4 Shrinkage

Readings of shrinkage in the unreinforced specimens are summarised in Table B.2.

B.2 STEEL PROPERTIES

The results of tensile tests on the reinforcing bars used are given in Table B.3. A Baty extensometer was used to measure extension over a two inch length. All bars were tested without being machined.

TABLE B.1

SUMMARY OF MODULUS OF ELASTICITY RESULTS
ON MORTAR MIX SPECIMENS

CYLINDERS			PRISMS		
STRESS (psi)	No. 4 (μS)	No. 37 (μS)	STRESS (psi)	No. 1 (μS)	No. 2 (μS)
0000	0000	0000	0000	0000	0000
353	124	102	500	155	145
707	242	216	1000	314	328
1061	366	350	1500	532	514
1414	498	502	2000	688	735
1768	640	624	2500	900	1015
2120	778	774	3000	1124	1308
2475	956	952	3500		1700
2830	1172	1146	3750	1436	1990
3180	1398	1374	4000	1644	2332
3360		1544	4125	1789	2664
3530	1720	1670	4250	2010	3102
3710	1944	1852	4375	2230	
3890	2222	2082			
4070		2312			
4250		2742			

Cylinders were 12" x 6" dia. with 4" demec gauge readings.

Prisms were 18" x 6" x 6" with 8" demec gauge readings.

The above readings are the average of two taken, in each case, from opposite sides of the specimen.

Sample 1: Average of 3 readings on 1.94" thick strip.

Sample 2: Average of 6 readings on two blocks 18" x 6" x 3.5".

Sample 3: Average of 6 readings on two blocks 18" x 7.5 x 3.5".

All readings in the above table have been corrected for temperature variations and thus represent the unrestrained shrinkage of the specimens. A value of 8 microstrains per degree Fahrenheit was taken in reducing the readings to an equivalent reading at 68°F.

TABLE B.2

SUMMARY OF SHRINKAGE AND TEMPERATURE MOVEMENT
READINGS TAKEN ON SAMPLES OF UNREINFORCED
CONCRETE SPECIMENS

			SHRINKAGE IN MICROSTRAIN		
DATE	TEMP.	TIME	SAMPLE 1	SAMPLE 2	SAMPLE 3
20/12/67	68	1300	0	0	0
21/12/67	66	0900	122	100	93
21/12/67	68	1200	129	108	103
22/12/67	66	0900	171	144	128
22/12/67	69	1700	193	163	151
23/12/67	68	1100	211	184	168
23/12/67	69	1800	219	189	172
24/12/67	63	1300	243	196	175
26/12/67	63	1100	300	258	234
27/12/67	68	1500	346	296	269
29/12/67	66	1200	395	331	300
1/01/68	68	0200	464	356	338
3/01/68	69	1100	583	446	406
4/01/68	72	1600	642	479	449
6/01/68	64	1600	670	488	452
8/01/68	66	0900	745	543	498
9/01/68	66	0900	754	551	505
10/01/68	70	0900	803	597	539
11/01/68	69	0900	790	586	528
12/01/68	70	0900	804	609	551
13/01/68	74	1100	881	644	586
15/01/68	69	1400	907	651	602
17/01/68	73	1500	993	691	658
18/01/68	67	1700	972	693	644
19/01/68	64	1400	945	698	640
23/01/68	70	0900	987	741	681
29/01/68	65	0900	925	739	679
3/02/68	65	1300	974	793	729
7/02/68	67	0900	1068	855	794
21/02/68		1500	1055	900	836
13/03/68	65	0900	1043	935	869
1/04/68		0900	1034	938	875
27/05/68	67	0930	1205	1102	1020

Table B.3. Tensile Tests on Reinforcement.

Steel Type	Nominal Diameter	Yield Force (lb)	No. Tested	Yield Stress (psi)	Modulus of Elasticity	Where Used	s.d. %
A	$\frac{3}{8}$"	4890	8	44,400	31.0×10^6	Beams Only	1.65
A	$\frac{1}{4}$"	1920	9	40,100	29.9×10^6	Beams Only	3.3
A	$\frac{1}{8}$"	616	8	50,300	29.8×10^6	Slab Beams	3.16
B	$\frac{1}{8}$"	502*	5	39,000	29.6×10^6	All Stir-rups	2.4

* .2% proof stress.

Type A: British steel, lead bath annealed to give extended yield plateau.

Type B: New Zealand soft drawn wire.

B.3 SLAB DIMENSIONS

B.3.1 Level of Top Surface of Floor and Beam and Panel Depths

Readings of level on the top surface before the test are shown in Figure B.1. Panel and beam depth measurements taken before the test are shown in Figure B.2.

Average thicknesses taken from the nine readings per panel were:

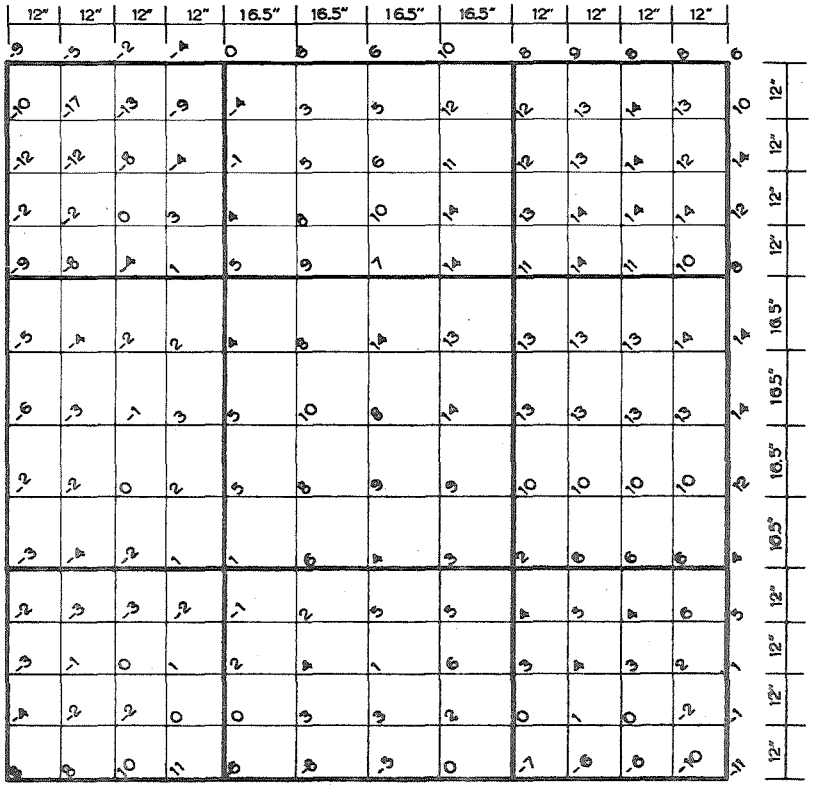


FIGURE B.1 LEVELS ON TOP SURFACE

N

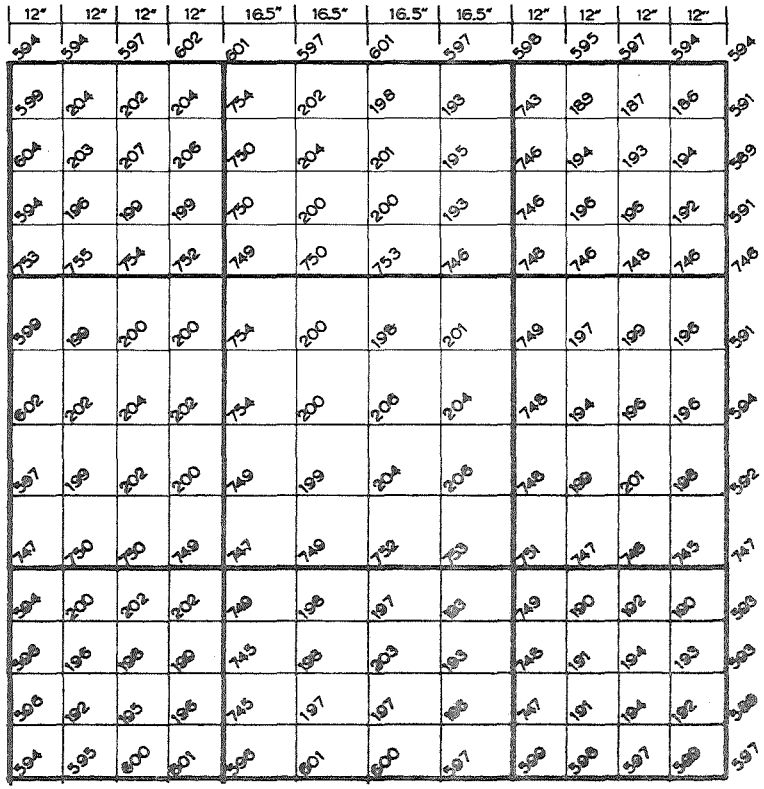


FIGURE B.2 DEPTHS OF BEAMS AND SLABS

All figures in .01 inch units

Panel	A	B	C	D	E	F	G	H	J
Average Thickness (in)	2.02	1.98	1.92	2.01	2.02	1.97	1.98	1.97	1.92
Std. Deviation (in)	.035	.055	.025	.017	.028	.020	.031	.028	.020

Readings taken at the edges of Panels E, H and J after the test gave the following results:

Panel	No. of Readings	Average Thickness (in)	Std. Dev. (in)
E	45	1.937	.031
H	43	1.908	.017
J	36	1.877	.018

B.3.2 Minimum Cover to Steel

Top steel cover was measured at the following positions:

(i) Around the edges of the centre panel at every bar

(ii) Around the edges of Panel H at every bar.

(iii) Around the edges of Panel J at every bar on two sides; every second bar on two sides.

(iv) At the interior supports of exterior and interior beams.

Bottom steel cover was checked along the principal cracks of Panels E, H and J and at the mid-span sections of the beams.

Results of the check are given in Table B.4.

Table B.4. Check on Minimum Steel Cover.

Position	No. of Read-ings	Expected Cover 1/64th in.	Average Cover 1/64th in.	Standard Deviation 1/64th in.	Remarks
Centre Panel Edge	28	12	11.6	2.7	EW layer top steel
Centre Panel Edge	28	20	15.5	2.5	NS layer top steel
Panel H Edge	20	12	10.7	1.6	EW layer top steel
Panel H Edge	28	20	16.8	2.2	NS layer top steel
Panel J Edge	15	12	9.6	2.0	EW layer top steel
Panel J Edge	15	20	17.4	2.0	NS layer top steel
Exterior Beam	40	24	24.6	3.9	Support top steel
Interior Beam	16	24	25.6	1.2	Support top steel
Exterior Beam	17	24	23.8	1.7	Centre span bottom steel
Interior Beam	37	24	23.3	1.7	Centre span bottom steel
Panel J	12	20	20.0	1.0	Top layer bottom steel
Panel J	16	12	12.0	.7	Bottom layer bottom steel
Panel E	30	20	21.3	2.3	Top layer bottom steel
Panel E	40	12	13.0	1.7	Bottom layer bottom steel
Panel H	10	20	20.2	.7	Top layer bottom steel
Panel H	33	12	12.0	1.2	Bottom layer bottom steel

APPENDIX C

DETAILS OF LOAD INCREMENTS FOR THE TEST ON THE NINE PANEL FLOOR

Column 1 - Load Stage Number.

Column 2-4 - Panel loads in lb/ft.^{2}

Column 5 - Temperature.

Column 6 - Time at which load first attained.

Column 7 - Time at which load changed for next stage.

LOAD STAGE NO	CENT PNL LOAD	RECT PNL LOAD	CRNR PNL LOAD	TEMP DEG F	TIME ON	TIME OFF	
1	75	75	75	71	1340	1400	TEST101
2	100	100	100	71	1400	1425	6/5/68
3	125	125	125	72	1425	1450	
4	150	150	150	71	1450	1515	
5	175	175	175	70	1515	1535	
6	200	200	200	70	1540	1603	
7	225	225	225		1605	1640	
8	200	200	200		1640	1655	
9	150	150	150		1655	1706	
10	75	75	75	69	1708		
13	75	75	75	65		1000	TEST102
14	100	100	100	67	1005	1020	7/5/68
15	125	125	125		1025	1037	
16	150	150	150	68	1041	1052	
17	175	175	175	69	1057	1109	
18	200	200	200	68	1114	1125	
19	225	225	225	68	1129	1140	
20	200	200	200	68	1143	1153	
21	175	175	175	69	1155	1205	
22	125	125	125	70	1208	1219	
23	75	75	75		1222		
26	75	75	75	70	1345	1355	TEST103
27	100	75	100	71	1400	1410	7/5/68
28	125	75	125	71	1415	1430	
29	150	75	150	71	1430	1443	
30	175	75	175	71	1445	1500	
31	200	75	200	72	1509	1525	
32	225	75	225	72	1530	1540	
33	200	75	200	72	1545	1557	
34	175	75	175	72	1602	1613	
35	150	75	150	72	1616	1626	
36	125	75	125	72	1632	1642	
37	100	75	100	72	1645	1656	
38	75	75	75	72	1700		
51	75	75	75	65		0918	TEST104
52	75	100	75	67	0925	0942	8/5/68
53	75	125	75		0945	1000	
54	75	150	75	68	1005	1015	
55	75	175	75	69	1020	1045	
56	75	200	75	70	1050	1100	
57	75	225	75	70	1105	1120	
58	75	200	75	71	1125	1134	
59	75	175	75	71	1138	1147	
60	75	150	75	71	1152	1205	
61	75	125	75	72	1208	1215	
63	75	75	75	71	1222		
1A	75	75	75	72		1355	TEST105
2A	100	100	100	72	1400	1408	8/5/68
3A	125	125	125	72	1412	1422	
4A	150	150	150	72	1425	1433	
5A	175	175	175	72	1440	1450	
6A	200	200	200	72	1455	1502	
7A	225	225	225	72	1515	1522	
8A	200	200	200	72	1526	1544	
9A	175	175	175	73	1547	1554	
10A	150	150	150	72	1559	1607	
11A	125	125	125	71	1612	1620	
12A	100	100	100	72	1624	1630	
13A	75	75	75	71	1640		
76	75	75	75	68		0906	TEST106
77	125	125	125	68	0910	0921	9/5/68
77A	150	150	150	70	0928	0932	
78	175	175	175	70	0943	0958	
78A	200	200	200	70	1005	1017	
79	225	225	225	70	1024	1035	
80	250	250	250	70	1040	1100	
81	275	275	275	70	1105	1125	
82	300	300	300	72	1133	1147	
83	325	325	325	72	1155	1207	
84	350	350	350	72	1215	1235	
85	375	375	375	72	1350	1408	
86	350	350	350	72	1415	1432	
87	325	325	325	72	1432	1443	
88	300	300	300	72	1443	1458	
89	275	275	275	72	1458	1518	
90	250	250	250	72	1520	1530	
91	225	225	225	72	1530	1545	
91A	200	200	200	72	1545	1555	TEST106
92	175	175	175	72	1555	1608	9/5/68
92A	150	150	150	72	1608	1623	
93	125	125	125	72	1625	1635	
94	75	75	75	72	1640		
95	75	75	75	67		0945	TEST107
95A	125	125	125	67	0950	1000	10/5/68
96	175	175	175	68	1005	1022	
96A	225	225	225	68	1040	1050	
97	275	275	275	69	1055	1105	
97A	325	325	325	69	1112	1122	
97B	350	350	350	70	1128	1135	
98	375	375	375	70	1140	1208	
99	375	325	325	71	1212	1222	
100	375	275	275	71	1225	1350	
101	375	225	225	71	1355	1405	
102	375	175	175	72	1410	1430	
102A	375	150	150		1435	1450	
103	375	125	125	73	1455	1520	
103A	375	100	100	73	1525	1535	
104	375	75	75	73	1540	1550	
105	325	75	75	73	1600	1608	
106	275	75	75	73	1612	1617	
107	225	75	75	72	1620	1630	
108	150	75	75	71	1635	1645	
109	75	75	75	72	1650		

LOAD STAGE NO	CENT PNL LOAD	RECT PNL LOAD	CRNR PNL LOAD	TEMP DEG F	TIME ON	TIME OFF	
114	75	75	75	66		0915	TEST108
115	125	75	125	67	0920	0935	13/5/68
116	175	75	175	68	0940	0948	
117	225	75	225	68	0953	1004	
118	250	75	250	68	1010	1022	
119	275	75	275	69	1027	1057	
120	300	75	300		1103	1112	
121	325	75	325	70	1120	1125	
122	350	75	350	70	1130	1145	
123	375	75	375	71	1150	1207	
123A	400	75	400	72	1210	1220	
123B	375	75	375	72	1225	1352	
124	350	75	350	74	1356	1409	
125	325	75	325	74	1415	1425	
126	300	75	300	74	1430	1440	
127	275	75	275	74	1445	1454	
128	250	75	250	75	1457	1504	
129	225	75	225	75	1521	1530	
130	175	75	175	75	1535	1545	
131	125	75	125	75	1550	1600	
132	75	75	75	75	1610		
133	75	75	75	72		0930	TEST109
134	75	125	75	72	0940	0953	14/5/68
135	75	175	75	73	0955	1010	
136	75	225	75	73	1015	1023	
137	75	250	75	73	1028	1040	
137A	200	250	200	73	1050	1100	
138	200	275	200		1105	1118	
139	200	300	200	74	1120	1135	
140	200	325	200	74	1140	1152	
141	200	350	200	74	1157	1207	
142	200	375	200	74	1212	1410	
142A	175	375	175	75	1410	1420	
142B	150	375	150	75	1425	1435	
143	150	350	150	75	1440	1450	
144	150	325	150	75	1455	1505	
145	150	300	150	74	1523	1533	
146	150	275	150		1538	1547	
147	150	250	150	75	1550	1556	
147A	75	250	75	75	1600	1608	
148	75	225	75	75	1612	1618	
149	75	175	75	75	1622	1630	
150	75	125	75	76	1636	1645	
151	75	75	75	75	1650		
152	75	75	75	74		0915	TEST110
152A	125	125	125	74	0920	0932	15/5/68
153	175	175	175	74	0935	0945	
153A	225	225	225	74	0950	1003	
154	275	275	275	74	1005	1020	
154A	300	300	300	74	1040	1105	
154B	325	325	325	74	1110	1120	
154C	350	350	350	73	1125	1140	
155	375	375	375	73	1145	1200	
156	400	400	400	73	1205	1355	
157	425	425	425	73	1400	1430	
158	450	450	450	73	1432	1545	
159	425	425	425	72	1550	1600	
160	400	400	400	72	1605	1610	
161	375	375	375	72	1615	/1400	16/5/68
162	350	350	353	71	1405	1418	
163	325	325	325	71	1423	1437	
164	275	275	275	71	1440	1455	
165	225	225	225	72	1500	1520	
166	175	175	175	72	1530	1540	
167	125	125	125	71	1545	1555	
168	75	75	75	71	1600	1615	TEST111
169	125	125	125	71	1620	1640	16/5/68
170	175	175	175	71	1645	1650	
171	225	225	225	70	1655	/0915	17/5/68
172	250	225	225	71	0920	0933	
173	275	225	225		0938	0947	

LOAD STAGE NO	CENT PNL LOAD	RECT PNL LOAD	CRNR PNL LOAD	TEMP DEG F	TIME ON	TIME OFF	
174	300	225	225	72	0950	1008	
175	325	225	225	72	1013	1030	
176	350	225	225		1045	1100	
177	375	225	225	72	1105	1125	
178	350	225	225	72	1130	1138	
179	325	225	225	72	1143	1150	
180	300	225	225	73	1155	1203	
181	275	225	225	74	1208	1215	
182	250	225	225	74	1215	1220	
183	225	225	225	74	1225	1350	
184	250	250	250	75	1355	1405	
185	275	275	275	75	1410	1418	
186	300	300	300	75	1423	1430	
187	325	325	325	75	1435	1445	
188	350	350	350	75	1450	1500	
189	375	375	375	68	1515	1000	20/5/68
190	400	400	400	67	1005	1025	TEST112
191	425	425	425		1045	1104	20/5/68
192	450	450	450	67	1110	1128	
193	475	475	475	67	1135	1155	
194	500	500	500	68	1200	1230	
195	300	300	300	69	1235	1400	
196	400	400	400	69	1408	1418	
197	450	450	450	69	1425	1432	
198	500	500	500	69	1440	1453	
199	525	525	525	69	1458	1535	
200	550	550	550		1540	1705	
201	400	400	400	69	1710	1720	
202	200	200	200	67	1725	/1015	21/5/68
203	300	300	300	66	1020	1030	
204	400	400	400	66	1045	1105	
205	500	500	500	66	1110	1122	
206	525	525	525	66	1127	1140	
207	550	550	550	67	1145	1202	
208	575	575	575	67	1210	1223	
209	375	375	375	67	1230	1345	
210	500	500	500	67	1350	1400	
211	550	550	550	67	1405	1410	
212	575	575	575	67	1415	1425	
213	600	600	600	68	1430	1512	
214	625	625	625	68	1520	1540	
215	650	650	650	69	1545	1600	
216	675	675	675		1610	1633	
217	700	700	700		1640	1703	
218	725	725	725		1710	1735	
219	750	750	750		1740	1750	
220	775	775	775		1755	1830	
221	400	400	400	62	1830	/0940	TEST113
222	600	600	600	62	0945	0955	22/5/68
223	750	750	750	63	1000	1020	
224	775	775	775		1025	1045	
225	800	800	800		1050	1108	
226	825	825	825	65	1115	1135	
227	850	850	850	67	1140	*	
228	556	556	556	67	1200	1340	
229	543	543	543	67	1345	1355	
230	600	600	600		1357	1420	
231	660	660	660	68	1425	1445	
232	710	710	710	68	1450	1515	
233	600	825	825	68	1520	1535	TEST114
234	600	850	850	68	1540	1550	
235	600	875	875	68	1550	1605	
236	600	900	900	69	1610	1620	
237	600	925	925	68	1625	1635	
238	600	950	950	68	1640	1700	
239	600	966	966			**	
	600	950	1170			***	

* 850 PSF NOT ATTAINED DUE TO FAILURE OF THE CENTRE PANEL.
** FAILURE OF RECTANGULAR PANELS.
*** FAILURE OF CORNER PANELS.

APPENDIX D

REDUCED DATA FROM SLAB TEST

D.1 DEFLECTIONS

Reduced readings of all deflection gauges with Load Stage 51 as datum are tabulated below. The first column contains the Load Stage Numbers, columns 2, 3 and 4 show the nominal panel loads in psf and the subsequent columns contain the deflection data in .0001 inch units. The numbers at the head of these columns refer to the dial gauge positions as given in Figure D.1.

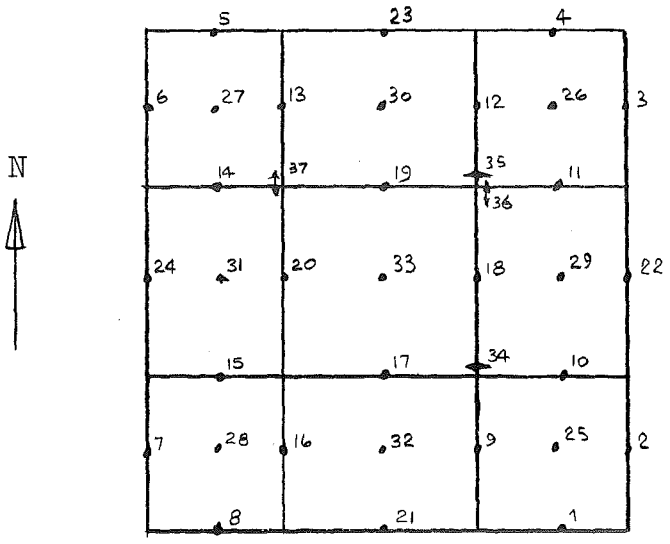


FIGURE D.1. DIAL GAUGE POSITIONS.

STAGE	CNTR	RCTR	CRNR	1	2	3	4	5	6	7	8	9	10	11	12	13
1.0	75.	75.	75.	-47	-276	-5	-56	-48	-42	-60	-14	-2	-50	-8	-57	-29
2.0	100.	100.	100.	-47	-270	5	-52	-40	-37	-50	-14	1	-35	17	-44	-24
3.0	125.	125.	125.	-31	-266	9	-42	-33	-29	-46	-17	-4	-21	2	-29	-10
4.0	150.	150.	150.	-24	-260	16	-35	-25	-24	-35	-9	4C	-4	24	-12	1
5.0	175.	175.	175.	-17	-254	19	-29	-18	-18	-25	-5	51	11	32	1	13
6.0	200.	200.	200.	-8	-246	27	-22	-5	-12	-23	-4	56	22	44	13	26
7.0	225.	225.	225.	-3	-231	32	-15	2	-9	-13	7	82	40	77	31	41
7.1	225.	225.	225.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
7.2	225.	225.	225.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
8.0	200.	200.	200.	2	-235	17	-22	0	-10	-15	10	82	35	59	-39	-34
9.0	150.	150.	150.	-6	-229	32	-32	-8	-18	-23	5	64	20	42	-42	-39
10.0	75.	75.	75.	-23	-198	19	-47	-28	-29	-25	-1	36	-11	13	-77	-39
13.0	75.	75.	75.	3	-181	29	-4	0	-4	-8	6	40	-10	-6	-60	-39
14.0	100.	100.	100.	4	-178	29	1	6	1	-3	9	47	0	4	11	11
15.0	125.	125.	125.	7	-170	32	8	9	4	0	6	48	1	2	16	26
16.0	150.	150.	150.	14	-164	36	16	12	10	8	11	55	18	24	23	33
17.0	175.	175.	175.	17	-160	41	20	18	13	11	15	65	28	27	28	37
18.0	200.	200.	200.	27	-150	47	25	22	19	18	20	72	37	33	36	43
19.0	225.	225.	225.	39	-148	48	27	28	1	20	22	76	45	42	43	51
20.0	200.	200.	200.	34	-146	49	25	25	1	20	21	82	39	34	40	44
21.0	175.	175.	175.	29	-143	45	18	20	21	20	21	82	31	25	34	40
22.0	125.	125.	125.	29	-141	42	8	15	13	10	14	66	15	14	22	26
23.0	75.	75.	75.	7	-177	31	3	9	3	0	-1	52	-6	-1	1	11
26.0	75.	75.	75.	9	-175	32	3	4	3	0	1	49	-5	2	2	10
27.0	100.	75.	100.	12	-169	38	7	10	9	7	4	49	-2	2	3	12
28.0	125.	75.	125.	19	-176	41	16	17	16	13	12	49	4	4	6	16
29.0	150.	75.	150.	24	-155	47	21	21	21	20	19	49	8	-1	10	18
30.0	175.	75.	175.	26	-2	27	27	29	23	22	22	62	19	12	12	21
31.0	200.	75.	200.	34	41	32	35	35	36	37	28	29	23	17	16	22
32.0	225.	75.	225.	39	48	37	41	42	41	42	34	29	27	17	20	22
33.0	200.	75.	200.	30	48	37	35	39	36	41	35	26	26	14	18	22
34.0	175.	75.	175.	30	39	32	27	31	32	33	34	28	22	12	14	21
35.0	150.	75.	150.	25	29	26	21	27	26	29	29	25	15	8	11	18
36.0	125.	75.	125.	19	19	17	16	20	21	21	19	19	14	4	9	13
37.0	100.	75.	100.	13	11	16	7	12	14	20	8	15	9	1	5	11
38.0	75.	75.	75.	6	7	9	1	5	10	10	-1	5	2	-3	1	9
51.0	75.	75.	75.	0	0	0	0	0	0	0	0	0	0	0	0	0
52.0	75.	100.	75.	-2	-2	-3	8	-2	-8	5	-9	4	5	2	7	9
53.0	75.	125.	75.	-5	-5	6	3	-3	-4	-5	-6	6	9	3	7	13
54.0	75.	150.	75.	-6	-8	9	1	-5	1	-7	4	7	13	5	9	16
55.0	75.	175.	75.	-10	-10	5	-3	-8	-1	-8	-12	11	19	13	12	20
56.0	75.	200.	75.	-13	-15	-2	-4	-10	-8	-11	-6	19	23	17	17	22
57.0	75.	225.	75.	-16	-19	-8	-6	-12	-9	-18	-17	21	28	21	21	26
58.0	75.	200.	75.	-13	-11	-2	-4	-9	-9	-11	-10	23	24	17	19	22
59.0	75.	175.	75.	-10	-10	0	-4	-7	-7	-9	-10	22	20	14	15	20
60.0	75.	150.	75.	-10	0	-2	-3	-1	1	-5	-5	17	15	9	10	17
61.0	75.	125.	75.	-13	-1	3	-3	0	1	-5	-2	9	8	4	6	13
63.0	75.	75.	75.	-2	2	9	5	5	6	1	5	5	0	-4	1	8
1.4	75.	75.	75.	-4	-1	7	4	5	6	1	9	6	-1	-4	0	8
2.4	100.	100.	100.	0	0	8	7	10	10	7	9	7	7	3	6	12
3.4	125.	125.	125.	2	-1	8	13	12	11	7	11	9	17	12	12	16
4.4	150.	150.	150.	6	1C	17	17	19	20	14	18	25	28	19	22	23
5.4	175.	175.	175.	14	12	18	23	22	20	20	20	28	40	24	28	31
6.4	200.	200.	200.	15	16	26	26	28	20	27	24	36	46	32	32	39
7.4	225.	225.	225.	23	25	28	33	30	24	30	29	40	53	35	36	41
8.4	200.	200.	200.	25	22	27	26	29	21	30	21	41	48	33	33	36
9.4	175.	175.	175.	20	11	27	22	25	21	30	19	34	38	26	27	31
10.4	150.	150.	150.	14	1C	26	17	20	16	25	16	24	30	19	21	22
11.4	125.	125.	125.	14	6	19	15	17	11	20	11	18	20	12	12	16
12.4	100.	100.	100.	7	C	17	7	11	11	15	6	9	10	2	6	10
13.4	75.	75.	75.	4	-9	12	4	8	6	10	0	2	0	-6	-2	2
76.0	75.	75.	75.	-5	-18	10	4	5	1	10	-2	2	0	-1	1	-2
77.0	125.	125.	125.	0	-3	12	10	11	6	19	9	14	18	4	26	16
77.1	150.	150.	150.	7	2	14	26	15	10	21	14	23	27	19	26	23
78.0	175.	175.	175.	12	10	28	27	21	23	28	19	29	37	24	22	31
78.1	200.	200.	200.	23	15	31	31	29	26	24	21	31	45	32	28	36
79.0	225.	225.	225.	25	20	33	35	31	26	38	29	36	53	38	34	41

STAGE	CNTR	RCTR	CRNR	1	2	3	4	5	6	7	8	9	10	11	12	13
80.0	250.	250.	250.	30	25	37	38	39	32	41	30	44	67	52	46	51
81.0	275.	275.	275.	36	22	38	47	45	38	49	36	50	80	67	62	62
82.0	300.	300.	300.	44	35	42	56	51	42	53	41	83	98	79	81	76
83.0	325.	325.	325.	46	45	44	61	60	51	60	49	99	114	94	92	89
84.0	350.	350.	350.	60	60	54	68	62	56	67	54	122	129	104	108	101
84.1	350.	350.	350.	60	60	57	68	62	51	67	54	129	130	104	108	101
84.2	350.	350.	350.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
85.0	375.	375.	375.	64	67	58	76	69	55	79	59	136	144	118	121	111
86.0	350.	350.	350.	63	62	58	72	65	55	75	54	127	135	114	120	111
87.0	325.	325.	325.	60	60	57	66	58	52	70	49	123	132	107	112	103
88.0	300.	300.	300.	58	58	56	61	58	51	67	47	118	125	102	111	98
89.0	275.	275.	275.	56	56	52	57	52	46	63	43	109	116	97	101	91
90.0	250.	250.	250.	56	52	48	52	50	41	60	39	101	108	89	94	86
91.0	225.	225.	225.	50	46	46	47	47	40	60	34	106	102	83	91	81
91.1	200.	200.	200.	45	35	38	45	45	36	55	29	101	91	75	89	76
92.0	175.	175.	175.	40	30	37	36	40	31	50	27	91	81	67	81	71
92.1	150.	150.	150.	35	20	29	34	31	26	48	23	91	71	62	76	65
93.0	125.	125.	125.	35	20	29	31	29	21	45	19	81	70	52	65	61
94.0	75.	75.	75.	17	6	17	18	25	11	35	9	62	59	39	53	49
95.0	75.	75.	75.	12	0	21	35	15	1	24	4	55	36	38	56	48
95.1	125.	125.	125.	15	9	28	37	25	21	32	14	63	66	52	61	59
96.0	175.	175.	175.	24	20	38	37	35	32	40	21	83	75	67	82	78
96.1	225.	225.	225.	43	35	42	46	40	39	49	30	90	97	82	92	89
97.0	275.	275.	275.	44	41	46	56	50	42	56	38	102	112	94	103	100
97.1	325.	325.	325.	52	50	52	67	59	51	65	46	130	126	108	114	110
97.2	350.	350.	350.	61	55	59	74	61	52	71	50	131	137	115	121	115
98.0	375.	375.	375.	64	60	63	76	66	57	75	55	133	148	122	126	121
99.0	375.	325.	325.	60	57	58	67	60	52	70	48	130	134	107	116	110
100.0	375.	275.	275.	55	50	47	57	51	46	62	39	101	118	94	106	108
100.1	375.	275.	275.	54	46	46	56	51	46	62	39	101	116	92	105	99
101.0	375.	225.	225.	47	40	42	47	45	41	57	29	103	101	75	92	83
102.0	375.	175.	175.	45	30	37	36	38	36	50	21	95	84	64	82	71
102.1	375.	150.	150.	35	25	29	33	35	31	45	17	87	76	58	78	62
103.0	375.	125.	125.	35	10	26	27	30	28	39	11	77	66	54	71	61
103.1	375.	100.	100.	30	10	24	19	25	21	35	9	68	56	44	62	51
104.0	375.	75.	75.	25	7	18	15	20	21	30	2	61	47	37	55	43
105.0	325.	75.	75.	25	7	17	15	20	21	28	2	58	45	37	55	43
106.0	275.	75.	75.	25	9	22	16	20	16	30	4	56	44	37	56	47
107.0	225.	75.	75.	25	9	22	16	20	16	30	4	43	42	38	56	47
108.0	150.	75.	75.	20	9	22	17	21	16	30	4	51	42	35	56	51
109.0	75.	75.	75.	20	9	27	21	22	16	30	9	46	35	42	58	53
114.0	75.	75.	75.	15	6	19	17	21	10	21	4	50	46	41	60	53
115.0	125.	75.	125.	24	12	27	42	32	19	34	17	58	47	54	73	60
116.0	175.	75.	175.	30	30	39	57	45	33	45	30	63	55	57	76	63
117.0	225.	75.	225.	45	42	56	70	60	52	60	44	68	70	64	76	73
118.0	250.	75.	250.	57	52	62	70	65	60	68	50	70	75	66	76	73
119.0	275.	75.	275.	66	69	67	76	72	66	76	56	86	80	69	77	77
120.0	300.	75.	300.	74	66	77	85	80	71	64	64	81	83	73	82	81
121.0	325.	75.	325.	80	72	80	91	87	79	71	71	85	85	77	84	82
122.0	350.	75.	350.	89	85	87	101	95	86	80	79	92	93	81	90	85
123.0	375.	75.	375.	95	97	99	108	105	96	90	86	98	100	84	91	87
123.1	400.	75.	400.	107	97	107	116	110	101	102	94	101	104	87	93	90
123.2	375.	75.	375.	103	92	102	111	105	98	102	89	96	101	84	91	86
123.3	375.	75.	375.	103	94	102	112	105	98	102	89	97	101	84	91	86
124.0	350.	75.	350.	97	90	97	106	105	95	105	59	97	98	75	91	85
125.0	325.	75.	325.	95	88	94	97	99	90	105	54	93	95	78	89	81
126.0	300.	75.	300.	93	82	89	94	92	86	95	49	91	89	74	86	76
127.0	275.	75.	275.	80	72	79	87	88	81	90	41	88	85	72	81	76
128.0	250.	75.	250.	79	70	77	80	82	72	90	37	86	82	67	81	73
129.0	225.	75.	225.	70	65	74	75	75	69	81	29	85	77	64	78	71
130.0	175.	75.	175.	60	51	62	59	61	54	61	19	79	67	59	72	66
131.0	125.	75.	125.	45	40	47	46	50	43	50	5	69	57	52	66	61
132.0	75.	75.	75.	33	17	27	28	37	31	40	-9	63	47	44	61	59
133.0	75.	75.	75.	21	8	27	25	30	21	32	-2	51	41	42	56	71
134.0	75.	125.	75.	16	1	17	23	25	14	29	-17	56	50	49	66	60
135.0	75.	175.	75.	10	-1	12	17	20	11	24	-22	63	55	57	71	62
136.0	75.	225.	75.	5	-8	6	11	15	6	15	-29	67	71	64	80	70

STAGE	CNTR	RCTR	CRNR	1	2	3	4	5	6	7	8	9	10	11	12	13
137.0	75.	250.	75.	0	-19	-1	7	9	1	12	-32	71	76	69	82	72
137.1	200.	250.	200.	32	30	28	44	41	36	48	4	84	97	85	92	83
138.0	200.	275.	200.	34	30	29	45	41	32	48	4	97	102	89	101	89
139.0	200.	300.	200.	34	32	32	41	40	31	42	0	110	107	95	101	91
140.0	200.	325.	200.	39	32	29	39	38	26	40	-1	110	113	98	103	93
141.0	200.	350.	200.	39	32	26	37	35	25	40	-6	111	116	101	106	94
142.0	200.	375.	200.	37	30	21	36	35	21	37	-6	112	115	103	111	99
142.1	200.	375.	200.	37	25	18	26	25	21	37	-9	112	121	104	111	100
142.2	175.	375.	175.	24	10	17	18	20	16	31	-14	119	118	102	111	97
142.3	150.	375.	150.	15	0	9	8	10	6	25	-21	111	115	97	108	93
143.0	150.	350.	150.	15	0	17	11	15	11	30	-20	108	111	96	103	91
144.0	150.	325.	150.	15	0	22	16	11	16	30	-16	92	107	94	96	91
145.0	150.	300.	150.	17	10	17	17	20	21	30	-15	90	102	89	91	86
146.0	150.	275.	150.	22	11	22	17	20	20	35	-11	88	95	84	91	84
147.0	150.	250.	150.	25	11	27	11	20	21	37	-9	84	92	82	89	81
147.1	75.	250.	75.	-5	-13	-6	-32	-23	-19	5	-38	78	75	71	81	71
148.0	75.	225.	75.	-3	-11	7	-14	-15	-14	12	-29	72	72	67	78	71
149.0	75.	175.	75.	5	-9	17	-5	-9	-7	15	-21	61	65	55	70	65
150.0	75.	125.	75.	9	-9	14	-1	0	1	30	-14	52	53	52	63	61
151.0	75.	75.	75.	17	8	21	5	6	6	32	-9	34	41	42	53	53
152.0	75.	75.	75.	15	7	17	7	1	1	30	-10	33	38	41	51	51
152.1	125.	125.	125.	17	18	19	19	10	10	35	-3	42	58	57	63	61
153.0	175.	175.	175.	21	21	23	24	18	16	40	5	58	77	72	76	72
153.1	225.	225.	225.	36	30	33	31	27	26	50	13	72	96	84	89	83
154.0	275.	275.	275.	44	32	37	41	35	33	58	21	82	110	98	99	95
154.1	300.	300.	300.	50	51	46	47	40	41	65	29	103	117	87	101	91
154.2	325.	325.	325.	55	59	52	57	45	46	65	30	107	125	92	103	61
154.3	350.	350.	350.	63	65	57	64	49	51	70	34	120	136	96	111	62
155.0	375.	375.	375.	64	68	59	71	51	53	77	39	124	143	106	114	71
156.0	400.	400.	400.	67	71	63	78	60	61	80	42	130	156	114	124	78
156.1	400.	400.	400.	71	72	69	81	72	71	90	44	136	162	119	131	81
157.0	425.	425.	425.	93	80	76	87	79	75	92	49	142	176	132	141	91
158.0	450.	450.	450.	95	81	77	90	80	71	98	49	175	190	147	161	68
159.0	425.	425.	425.	75	75	78	86	78	71	90	44	165	185	144	161	64
160.0	400.	400.	400.	75	77	77	79	74	71	90	41	165	178	135	151	59
161.0	375.	375.	375.	67	70	67	73	70	71	90	39	163	171	133	151	54
161.1	375.	375.	375.	67	70	67	73	70	71	90	39	162	170	133	146	54
161.2	375.	375.	375.	70	70	67	73	70	69	86	35	162	173	134	152	61
161.3	375.	375.	375.	70	75	67	76	72	63	86	39	162	176	139	153	61
161.4	375.	375.	375.	70	75	67	79	76	66	90	44	174	175	141	151	152
161.5	375.	375.	375.	72	75	67	80	76	66	90	44	174	175	141	151	152
162.0	350.	350.	350.	69	70	59	76	71	61	80	39	154	168	134	142	144
163.0	325.	325.	325.	65	65	57	71	69	61	77	36	154	162	131	141	142
164.0	275.	275.	275.	57	60	49	63	60	56	67	29	145	147	115	131	131
165.0	225.	225.	225.	47	50	47	56	55	56	60	21	135	131	107	120	118
166.0	175.	175.	175.	41	40	42	46	49	46	52	10	121	112	94	111	111
167.0	125.	125.	125.	30	20	27	36	41	40	48	4	97	92	79	93	100
168.0	75.	75.	75.	21	15	18	26	35	31	22	-8	85	70	63	81	88
169.0	125.	125.	125.	29	25	29	35	40	41	41	1	92	87	78	131	60
170.0	175.	175.	175.	36	32	37	43	49	46	54	9	97	104	92	140	54
171.0	225.	225.	225.	45	40	45	51	52	51	60	15	107	122	104	151	63
171.1	225.	225.	225.	45	40	47	53	55	53	60	15	114	125	105	153	61
172.0	250.	225.	225.	45	44	46	61	55	48	62	19	123	130	117	162	56
173.0	275.	225.	225.	47	45	48	73	55	51	60	19	123	130	113	159	56
174.0	300.	225.	225.	47	42	49	73	55	53	60	20	123	130	109	161	59
175.0	325.	225.	225.	50	42	50	58	57	61	62	23	123	130	104	152	61
176.0	350.	225.	225.	48	44	54	57	57	61	63	23	123	130	104	152	56
177.0	375.	225.	225.	46	43	52	57	56	56	65	22	123	130	103	150	54
178.0	350.	225.	225.	46	46	54	57	56	56	65	22	124	130	100	151	62
179.0	325.	225.	225.	47	47	53	57	58	56	61	22	124	130	105	152	61
180.0	300.	225.	225.	51	47	54	57	60	56	64	24	124	130	106	153	61
181.0	275.	225.	225.	54	45	56	56	59	53	61	24	124	131	107	156	61
182.0	250.	225.	225.	53	49	51	56	59	53	62	25	127	131	108	161	96
183.0	225.	225.	225.	54	50	52	46	59	53	62	25	127	131	109	191	98
183.1	225.	225.	225.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
184.0	250.	250.	250.	55	52	56	52	61	56	70	28	125	136	117	198	103
185.0	275.	275.	275.	56	59	57	57	65	61	75	30	127	144	122	201	110

STAGE	CNTR	RCTR	CRNR	1	2	3	4	5	6	7	8	9	10	11	12	13
186.0	300.	300.	300.	59	60	57	66	69	63	79	35	131	151	127	206	114
187.0	325.	325.	325.	65	67	61	71	71	70	81	36	140	160	133	211	120
188.0	350.	350.	350.	65	70	66	77	75	72	87	41	144	167	136	215	126
189.0	375.	375.	375.	73	85	69	86	80	72	90	46	155	176	147	221	131
189.1	375.	375.	375.	75	82	67	86	80	77	97	44	175	175	147	211	113
189.2	375.	375.	375.	75	78	64	78	74	69	90	44	168	177	139	205	113
189.3	375.	375.	375.	71	74	68	74	68	71	84	35	169	177	143	210	118
189.4	375.	375.	375.	72	73	64	72	69	71	84	41	165	177	143	208	116
189.5	375.	375.	375.	75	74	65	74	71	70	84	41	169	175	141	211	120
189.6	375.	375.	375.	78	81	70	77	72	72	86	44	170	183	145	213	122
189.7	375.	375.	375.	79	81	75	77	72	72	88	45	171	183	150	213	122
189.8	375.	375.	375.	79	81	72	77	75	73	90	44	173	184	151	216	129
190.0	400.	400.	400.	84	81	75	83	79	76	91	50	181	192	157	221	131
191.0	425.	425.	425.	86	92	78	88	85	81	98	55	188	200	168	226	141
192.0	450.	450.	450.	92	95	82	96	89	83	100	59	196	207	170	231	144
193.0	475.	475.	475.	94	102	88	103	91	87	107	64	197	216	178	235	150
194.0	500.	500.	500.	99	110	90	109	98	91	110	70	213	231	191	256	163
195.0	300.	300.	300.	74	70	67	73	71	71	82	39	161	180	148	216	123
196.0	400.	400.	400.	90	89	77	95	87	86	100	54	156	205	173	238	146
197.0	450.	450.	450.	95	99	87	103	90	82	105	60	200	221	184	256	152
198.0	500.	500.	500.	97	104	95	106	98	91	111	74	209	236	197	259	162
199.0	525.	525.	525.	103	111	97	120	102	93	116	79	217	247	211	270	172
199.1	525.	525.	525.	116	117	107	128	103	97	122	80	241	255	218	271	176
200.0	550.	550.	550.	119	118	108	136	109	102	135	85	241	274	239	283	190
200.1	550.	550.	550.	124	120	109	141	165	126	138	87	247	278	271	281	193
200.4	550.	550.	550.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
201.2	550.	550.	550.	140	225	116	226	172	132	190	94	317	496	337	290	201
201.0	400.	400.	400.	115	190	104	196	150	121	170	71	289	453	292	256	171
202.0	200.	200.	200.	77	152	82	150	115	101	125	39	229	271	222	211	126
202.1	200.	200.	200.	74	141	67	146	110	82	115	34	215	264	214	205	117
203.0	300.	300.	300.	90	155	79	167	121	91	127	45	229	298	247	226	142
204.0	400.	400.	400.	107	172	89	191	142	101	132	67	247	338	281	248	163
205.0	500.	500.	500.	116	201	102	211	160	112	170	81	286	381	316	270	186
206.0	525.	525.	525.	135	206	107	218	165	114	180	88	297	388	327	277	190
207.0	550.	550.	550.	137	222	117	227	169	121	186	90	311	395	339	282	196
208.0	575.	575.	575.	171	241	124	238	180	132	192	96	333	426	366	326	253
209.0	375.	375.	375.	188	211	102	244	150	121	180	69	302	373	315	291	222
209.1	375.	375.	375.	182	212	99	243	149	116	157	67	297	375	317	291	222
210.0	500.	500.	500.	205	232	104	268	170	122	172	84	315	407	356	316	250
211.0	550.	550.	550.	211	241	116	294	180	131	189	92	323	428	372	329	261
212.0	575.	575.	575.	225	249	118	295	185	133	191	98	332	444	384	340	273
213.0	600.	600.	600.	234	268	134	345	212	141	195	129	362	475	462	478	391
213.1	600.	600.	600.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
214.0	625.	625.	625.	306	339	140	393	237	208	160	289	475	576	607	528	471
215.0	650.	650.	650.	335	360	192	416	312	256	272	239	517	654	667	572	583
216.0	675.	675.	675.	491	400	204	513	310	271	375	344	603	680	1412	693	631
217.0	700.	700.	700.	512	450	212	623	410	436	425	391	715	1188	1642	801	881
218.0	725.	725.	725.	625	540	407	817	527	471	505	434	974	-87	2506	1126	1066
219.0	750.	750.	750.	758	610	452	1011	741	511	592	511	1177	1712	3317	1431	1301
220.0	775.	775.	775.	900	1000	527	1346	1160	691	950	656	1591	2202	4307	1811	1701
221.0	800.	800.	800.	825	935	469	1276	1110	526	860	484	1475	2123	3652	1661	1565
222.0	600.	600.	600.	895	1010	517	1355	1160	551	920	539	1540	2275	4267	1761	1651
223.0	750.	750.	750.	965	1090	587	1426	1240	611	990	599	1645	2555	4397	1871	1771
224.0	775.	775.	775.	1045	1230	627	1536	1360	641	1080	665	1795	2713	4577	2021	1911
225.0	800.	800.	800.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
226.0	825.	825.	825.	1435	1560	877	2136	1900	881	1630	1029	2397	2643	6447	2731	2661
227.0	850.	850.	850.	-555	-750	-623	-654	-340	-779	-110	-71	-7	-87	-253	-109	-39
228.0	557.	557.	557.	1656	1790	1167	2366	2170	1031	1860	1149	2665	3038	7407	3101	3071
229.0	543.	543.	543.	1655	1790	1157	2356	2170	1031	1860	1139	2655	3000	7402	3091	3071
230.0	606.	606.	606.	1685	1792	1157	2366	2170	1031	1860	1149	2665	3080	7437	3121	3101
231.0	659.	659.	659.	1672	1792	1157	2378	2182	1021	1870	1158	2712	3000	7471	3151	3131
232.0	710.	710.	710.	1695	1810	1157	2391	2192	1031	1890	1170	2736	3000	7511	3191	3166
233.0	600.	825.	825.	1757	1850	1169	2446	2251	1071	1940	1218	2869	3038	7647	3336	3331
234.0	600.	850.	850.	1785	1870	1176	2478	2287	1081	1985	1246	2985	-3353	8307	3468	3471
235.0	600.	875.	875.	1862	2011	1189	2611	2415	1122	2090	1375	3095	-3353	8537	3711	3751
236.0	600.	900.	900.	1985	2112	1287	2801	2595	1216	2175	1544	3224	-3353	9422	4061	4086
237.0	600.	925.	925.	2235	2372	1317	3156	2850	1331	2280	1629	-3261	-87	11212	4691	4661

STAGE	CNTR	RCTR	CRNR	14	15	16	17	18	19	20	21	22	23	24	25	26
1.0	75.	75.	75.	-55	-46	-17	-58	-100	50	-100	-20	-30	-55	-61	-45	-30
2.0	100.	100.	100.	-46	-33	-10	-40	-70	50	-80	-10	-10	-45	-51	-30	-10
3.0	125.	125.	125.	-33	-21	-3	-15	-40	50	-55	0	-10	-36	-36	-10	10
4.0	150.	150.	150.	-18	-1	3	10	-27	50	-26	11	8	-26	-21	10	30
5.0	175.	175.	175.	-3	9	21	35	5	50	-5	30	30	-16	-5	30	50
6.0	200.	200.	200.	10	3	21	60	21	50	24	45	45	-5	5	50	50
7.0	225.	225.	225.	25	30	36	85	60	50	65	45	58	24	24	70	91
7.1	225.	225.	225.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
7.2	225.	225.	225.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
8.0	200.	200.	200.	27	34	41	80	110	50	55	40	50	-4	10	60	70
9.0	150.	150.	150.	5	17	36	50	88	50	35	10	30	-15	-3	33	39
10.0	75.	75.	75.	-5	-13	6	5	45	50	25	-10	-1	-39	-41	-15	-10
13.0	75.	75.	75.	0	2	-17	-9	5	-12	-10	-5	-10	-7	-6	0	-8
14.0	100.	100.	100.	7	12	-7	5	15	0	-6	5	2	4	4	15	15
15.0	125.	125.	125.	15	20	1	18	26	10	5	10	10	35	11	27	30
16.0	150.	150.	150.	24	27	9	30	48	20	17	15	20	15	15	45	55
17.0	175.	175.	175.	31	36	16	43	65	30	25	20	29	17	32	60	70
18.0	200.	200.	200.	40	43	20	60	65	42	46	28	35	25	35	75	82
19.0	225.	225.	225.	46	51	22	70	72	80	60	30	45	35	50	90	100
20.0	200.	200.	200.	42	44	23	60	60	50	47	28	40	26	45	80	85
21.0	175.	175.	175.	35	36	23	50	50	30	40	20	35	20	35	65	71
22.0	125.	125.	125.	16	24	21	25	30	18	36	10	19	10	20	38	42
23.0	75.	75.	75.	4	10	7	0	0	-5	-15	-1	0	-2	-1	5	11
26.0	75.	75.	75.	4	7	3	-1	0	-5	-17	-4	-5	-4	-1	6	13
27.0	100.	75.	100.	5	6	3	-16	0	0	-10	-11	-12	-10	-11	20	30
28.0	125.	75.	125.	8	13	1	10	10	5	-5	-15	-17	-14	-11	35	41
29.0	150.	75.	150.	13	17	1	13	22	10	5	-20	-20	-15	-11	55	60
30.0	175.	75.	175.	16	19	-7	20	30	15	25	-25	-19	-22	-11	65	70
31.0	200.	75.	200.	20	22	9	29	20	20	30	-30	-22	-25	-16	85	85
32.0	225.	75.	225.	24	25	11	32	40	25	40	-35	-25	-33	-21	100	100
33.0	200.	75.	200.	22	23	14	30	40	20	25	-26	-20	-25	-16	85	85
34.0	175.	75.	175.	22	19	11	22	30	15	25	-22	-18	-17	-11	70	70
35.0	150.	75.	150.	21	14	10	18	25	10	20	-19	-15	-17	-11	55	55
36.0	125.	75.	125.	20	12	6	15	20	5	15	-15	-10	-16	-6	45	40
37.0	100.	75.	100.	5	7	1	5	11	0	5	-10	-10	-10	-1	25	20
38.0	75.	75.	75.	6	2	-1	0	0	-5	-5	-2	-5	-5	-1	3	10
51.0	75.	75.	75.	0	0	0	0	0	0	0	0	0	0	0	0	0
52.0	75.	100.	75.	5	2	-2	5	10	2	1	15	10	16	19	0	1
53.0	75.	125.	75.	6	8	5	10	15	8	10	25	20	25	25	0	0
54.0	75.	150.	75.	11	12	9	20	20	13	15	40	33	35	44	-2	-2
55.0	75.	175.	75.	15	17	5	21	25	20	25	50	45	50	59	-3	-2
56.0	75.	200.	75.	17	22	6	30	30	25	30	60	60	55	74	-3	-2
57.0	75.	225.	75.	24	28	21	40	45	30	35	70	72	65	84	-5	-5
58.0	75.	200.	75.	21	22	10	30	32	35	30	60	60	57	74	-5	-2
59.0	75.	175.	75.	23	19	8	25	30	20	25	52	50	45	59	0	0
60.0	75.	150.	75.	21	13	6	15	20	15	15	45	38	35	45	-2	-1
61.0	75.	125.	75.	21	11	10	10	15	10	10	35	25	25	35	-5	0
63.0	75.	75.	75.	3	2	-12	0	5	0	-5	10	0	6	9	-5	0
1.4	75.	75.	75.	2	1	-9	0	5	0	-5	10	-5	6	9	0	0
2.4	100.	100.	100.	6	9	-4	10	20	10	10	15	2	10	14	15	15
3.4	125.	125.	125.	15	15	12	20	30	20	25	20	10	15	19	25	30
4.4	150.	150.	150.	24	23	11	35	40	30	35	30	20	25	34	45	45
5.4	175.	175.	175.	31	32	19	50	60	40	47	33	30	25	44	55	56
6.4	200.	200.	200.	36	37	31	60	70	50	65	40	42	25	57	75	70
7.4	225.	225.	225.	45	43	32	75	85	60	80	40	50	40	61	85	90
8.4	200.	200.	200.	40	39	22	60	80	52	65	40	45	35	57	75	75
9.4	175.	175.	175.	35	32	21	50	65	45	50	35	35	30	45	60	60
10.4	150.	150.	150.	25	23	17	40	55	30	40	30	30	25	35	45	40
11.4	125.	125.	125.	17	17	6	25	45	20	30	20	20	17	25	35	30
12.4	100.	100.	100.	8	7	0	10	30	10	15	15	10	10	15	16	15
13.4	75.	75.	75.	0	1	-9	0	15	0	-5	10	0	5	9	0	-2
76.0	75.	75.	75.	-3	1	-17	0	20	0	-5	8	1	6	8	3	0
77.0	125.	125.	125.	20	15	3	30	40	30	35	15	15	26	25	33	38
77.1	150.	150.	150.	25	24	12	40	50	39	45	25	25	27	35	45	52
78.0	175.	175.	175.	32	31	21	51	65	48	53	30	32	34	44	60	61
78.1	200.	200.	200.	37	38	28	65	76	58	65	40	41	35	54	73	75
79.0	225.	225.	225.	44	44	33	80	95	70	84	42	50	40	64	85	90

STAGE	CNTR	RCTR	CRNR	14	15	16	17	18	19	20	21	22	23	24	25	26
80.0	250.	250.	250.	55	57	42	100	120	90	105	50	62	47	77	105	108
81.0	275.	275.	275.	66	71	60	128	145	113	130	60	73	60	85	125	120
82.0	300.	300.	300.	82	92	76	170	175	155	155	70	88	71	104	144	150
83.0	325.	325.	325.	94	97	81	200	205	180	185	80	102	82	115	165	170
84.0	350.	350.	350.	107	111	96	240	255	230	226	105	121	90	134	185	190
84.1	350.	350.	350.	107	112	101	250	260	235	227	102	128	100	144	188	190
84.2	350.	350.	350.	-55	-88	-129	-240	-495	-50	-355	-380	-250	-395	-61	-245	-430
85.0	375.	375.	375.	120	122	111	262	285	261	253	110	140	110	154	205	210
86.0	350.	350.	350.	115	117	111	265	275	250	245	105	130	105	145	205	200
87.0	325.	325.	325.	110	112	107	255	265	240	234	100	120	103	135	195	187
88.0	300.	300.	300.	105	102	101	240	255	226	215	90	120	97	131	165	175
89.0	275.	275.	275.	95	97	91	230	237	215	205	85	112	90	124	155	160
90.0	250.	250.	250.	90	92	81	215	233	201	190	80	105	85	119	145	150
91.0	225.	225.	225.	81	82	78	200	225	190	175	75	93	78	104	130	133
91.1	200.	200.	200.	75	77	71	190	205	180	165	70	81	75	95	115	121
92.0	175.	175.	175.	67	67	61	175	190	170	145	60	78	67	86	105	110
92.1	150.	150.	150.	62	62	52	160	175	158	135	50	65	63	83	87	98
93.0	125.	125.	125.	47	57	40	145	163	140	118	46	58	55	65	75	80
94.0	75.	75.	75.	37	39	29	115	135	120	95	32	33	44	49	45	50
95.0	75.	75.	75.	35	34	33	115	125	112	97	30	35	55	44	36	50
95.1	125.	125.	125.	45	50	42	141	147	135	123	40	50	66	55	60	75
96.0	175.	175.	175.	62	64	57	170	175	160	147	58	63	65	74	90	90
96.1	225.	225.	225.	75	80	71	196	205	185	175	70	90	75	94	117	130
97.0	275.	275.	275.	86	93	82	220	235	210	203	80	105	86	109	145	155
97.1	325.	325.	325.	105	109	96	250	263	239	245	92	123	100	129	175	186
97.2	350.	350.	350.	112	114	101	270	285	250	250	102	138	105	149	187	200
98.0	375.	375.	375.	117	121	107	282	305	265	265	110	147	115	165	205	219
99.0	375.	325.	325.	106	111	99	280	303	260	258	100	132	105	148	180	192
100.0	375.	275.	275.	95	97	88	270	295	253	250	83	118	93	129	155	166
100.1	375.	275.	275.	94	96	89	270	295	253	250	82	112	93	125	156	165
101.0	375.	225.	225.	77	82	72	260	295	250	244	70	99	80	110	127	123
102.0	375.	175.	175.	65	67	61	250	287	240	230	62	79	67	92	102	105
102.1	375.	150.	150.	55	61	52	248	284	239	226	40	75	56	74	86	93
103.0	375.	125.	125.	47	52	46	240	276	233	224	35	55	50	64	75	80
103.1	375.	100.	100.	40	45	38	235	275	230	217	25	40	44	49	55	62
104.0	375.	75.	75.	32	37	31	230	266	227	210	15	30	34	39	40	48
105.0	325.	75.	75.	32	37	31	205	250	210	195	17	30	34	39	40	46
106.0	275.	75.	75.	34	37	28	200	228	195	177	20	32	35	39	41	50
107.0	225.	75.	75.	34	37	32	181	210	180	163	20	32	35	39	41	50
108.0	150.	75.	75.	35	37	31	155	207	150	135	21	35	40	39	41	50
109.0	75.	75.	75.	35	37	31	130	147	128	107	25	38	44	39	41	50
114.0	75.	75.	75.	35	38	42	130	140	130	107	21	31	45	39	45	55
115.0	125.	75.	125.	44	47	43	142	164	145	124	19	22	40	39	75	91
116.0	175.	75.	175.	50	52	49	160	175	152	135	6	8	25	39	105	122
117.0	225.	75.	225.	57	60	54	170	195	165	150	0	10	25	22	135	151
118.0	250.	75.	250.	60	62	57	180	205	170	155	-5	5	16	19	154	170
119.0	275.	75.	275.	65	67	59	185	215	180	165	-10	2	7	19	166	182
120.0	300.	75.	300.	70	71	61	190	225	185	170	-15	0	5	10	188	200
121.0	325.	75.	325.	73	74	71	200	237	190	177	-20	-5	-5	5	200	218
122.0	350.	75.	350.	75	77	71	210	245	200	185	-30	-5	-10	4	215	232
123.0	375.	75.	375.	80	82	78	212	265	201	195	-30	-15	-15	0	235	250
123.1	400.	75.	400.	84	87	86	220	273	210	205	-37	-18	-22	-1	250	268
123.2	375.	75.	375.	80	82	78	215	265	205	196	-30	-11	-16	-1	238	251
123.3	375.	75.	375.	80	82	74	215	266	205	196	-35	-11	-17	-1	245	259
124.0	350.	75.	350.	77	78	71	210	250	199	195	-30	-15	-15	-1	230	245
125.0	325.	75.	325.	75	76	69	201	240	192	185	-28	-20	-13	0	215	230
126.0	300.	75.	300.	67	72	66	191	235	185	175	-26	-19	-7	4	203	215
127.0	275.	75.	275.	65	69	61	190	225	180	167	-20	-10	-3	8	186	200
128.0	250.	75.	250.	65	66	56	180	215	172	160	-15	-10	3	5	175	186
129.0	225.	75.	225.	57	62	51	181	210	168	155	-10	-5	5	5	160	170
130.0	175.	75.	175.	52	56	41	160	194	155	145	0	0	15	15	128	140
131.0	125.	75.	125.	42	46	41	145	175	140	126	10	15	25	28	100	104
132.0	75.	75.	75.	36	42	35	131	156	130	115	20	25	35	31	65	73
133.0	75.	75.	75.	30	37	28	131	147	130	114	21	28	44	35	46	52
134.0	75.	125.	75.	40	43	41	145	160	145	125	50	59	66	61	46	55
135.0	75.	175.	75.	46	52	43	160	175	160	135	70	82	85	85	45	52
136.0	75.	225.	75.	55	60	52	171	185	170	150	95	110	100	114	45	50

STAGE	CNTR	RCTR	CRNR	14	15	16	17	18	19	20	21	22	23	24	25	26
137.0	75.	250.	75.	56	63	53	180	190	173	155	110	122	118	129	40	50
137.1	200.	250.	200.	77	77	70	210	225	203	195	82	162	96	117	114	122
138.0	200.	275.	200.	96	82	71	220	244	210	197	95	115	105	131	115	125
139.0	200.	300.	200.	95	89	76	230	245	220	205	102	125	115	145	115	125
140.0	200.	325.	200.	90	92	81	235	247	225	215	111	140	127	155	115	125
141.0	200.	350.	200.	94	94	83	240	255	230	220	130	155	144	170	115	123
142.0	200.	375.	200.	95	101	87	250	285	240	225	141	170	164	185	115	120
142.1	200.	375.	200.	35	101	87	250	285	242	225	141	170	209	150	110	120
142.2	175.	375.	175.	93	93	91	245	265	240	225	153	165	215	200	90	102
142.3	150.	375.	150.	93	95	80	240	257	231	225	162	200	225	218	85	85
143.0	150.	350.	150.	90	92	76	232	255	228	215	151	190	213	194	85	90
144.0	150.	325.	150.	85	87	71	225	255	220	168	139	160	208	185	85	85
145.0	150.	300.	150.	80	83	61	220	244	213	165	130	142	194	174	85	89
146.0	150.	275.	150.	75	75	61	213	234	210	156	120	130	182	162	85	90
147.0	150.	250.	150.	70	74	59	210	225	200	155	110	120	166	149	85	90
147.1	75.	250.	75.	56	64	46	185	205	185	135	121	138	193	169	85	31
148.0	75.	225.	75.	58	62	53	180	195	180	125	112	120	177	152	43	39
149.0	75.	175.	75.	45	53	51	165	183	165	110	91	95	155	129	41	40
150.0	75.	125.	75.	40	44	41	150	166	151	97	68	79	130	96	45	42
151.0	75.	75.	75.	30	37	31	140	155	140	85	41	56	109	69	45	42
152.0	75.	75.	75.	30	37	38	140	146	140	45	30	49	98	67	43	42
152.1	125.	125.	125.	44	51	46	169	175	160	114	42	58	114	84	67	72
153.0	175.	175.	175.	47	64	56	192	200	190	135	59	75	125	100	95	102
154.1	225.	225.	225.	70	75	66	220	225	211	165	72	91	139	119	125	130
154.0	275.	275.	275.	85	92	78	250	265	240	195	81	110	154	134	155	160
154.1	300.	300.	300.	95	101	81	261	276	250	225	100	146	166	144	165	168
154.2	325.	325.	325.	105	108	91	280	286	260	235	105	146	185	159	184	178
154.3	350.	350.	350.	110	114	101	300	301	272	257	120	152	174	169	200	192
155.0	375.	375.	375.	116	122	103	310	315	290	274	121	165	184	179	215	210
156.0	400.	400.	400.	124	132	123	339	363	300	296	131	179	195	191	235	230
156.1	400.	400.	400.	132	132	116	360	380	330	295	142	159	206	209	245	239
157.0	425.	425.	425.	143	144	126	382	405	355	285	155	210	222	227	265	259
158.0	450.	450.	450.	155	154	141	550	409	540	435	320	340	367	359	365	291
159.0	425.	425.	425.	154	151	121	532	535	495	427	320	350	370	405	293	282
160.0	400.	400.	400.	145	142	119	520	511	480	415	311	340	369	398	277	270
161.0	375.	375.	375.	142	137	111	509	495	470	404	305	330	356	385	265	258
161.1	375.	375.	375.	142	137	126	509	495	469	405	301	330	356	389	265	258
161.2	375.	375.	375.	138	138	126	509	499	471	408	302	331	356	387	268	260
161.3	375.	375.	375.	145	142	140	519	501	480	414	295	284	356	388	278	270
161.4	375.	375.	375.	147	143	140	519	475	490	401	311	341	368	389	285	300
161.5	375.	375.	375.	147	143	140	519	475	490	401	309	341	364	385	288	300
162.0	350.	350.	350.	143	137	132	505	465	478	387	300	331	357	379	276	282
163.0	325.	325.	325.	136	132	116	491	453	461	375	292	322	352	365	265	270
164.0	275.	275.	275.	124	119	106	460	430	435	345	280	351	336	346	236	241
165.0	225.	225.	225.	110	107	101	439	400	409	310	258	280	324	328	206	215
166.0	175.	175.	175.	95	92	76	390	360	376	275	240	251	302	299	175	183
167.0	125.	125.	125.	82	77	61	359	320	345	238	218	223	285	259	140	150
168.0	75.	75.	75.	65	64	56	319	280	311	235	199	192	265	244	105	116
169.0	125.	125.	125.	82	78	72	350	305	331	245	210	209	62	258	135	130
170.0	175.	175.	175.	95	92	86	380	335	360	275	222	230	75	284	162	160
171.0	225.	225.	225.	107	107	98	410	370	390	305	240	259	94	304	195	190
171.1	225.	225.	225.	110	110	100	418	370	392	305	243	259	95	307	197	195
172.0	250.	225.	225.	106	110	101	425	405	403	318	242	260	95	309	200	192
173.0	275.	225.	225.	107	108	96	433	413	411	330	245	266	106	310	203	192
174.0	300.	225.	225.	107	108	102	440	430	420	340	245	265	105	310	200	205
175.0	325.	225.	225.	107	108	100	450	440	428	345	242	261	96	310	200	189
176.0	350.	225.	225.	107	107	100	460	453	435	355	240	260	100	309	200	198
177.0	375.	225.	225.	106	106	93	470	465	445	365	240	260	93	309	197	193
178.0	350.	225.	225.	106	106	93	460	455	438	356	241	260	95	309	197	195
179.0	325.	225.	225.	106	107	97	458	425	430	350	246	260	95	309	198	196
180.0	300.	225.	225.	110	105	98	449	415	420	345	245	260	95	309	200	199
181.0	275.	229.	225.	108	111	98	439	405	410	334	250	260	95	309	205	205
182.0	250.	225.	225.	110	111	100	420	365	410	315	243	261	124	308	205	208
183.0	225.	225.	225.	113	112	101	420	365	400	305	243	261	124	304	205	209
183.1	225.	225.	225.	-55	-88	-129	419	364	400	304	245	261	125	304	205	210
184.0	250.	250.	250.	117	107	111	430	375	412	318	250	270	132	314	215	220
185.0	275.	275.	275.	125	122	122	445	386	429	335	260	280	140	324	230	235

STAGE	CNTR	RCTR	CRNR	14	15	16	17	18	19	20	21	22	23	24	25	26
186.0	300.	300.	300.	134	129	120	460	405	440	354	270	291	147	338	245	250
187.0	325.	325.	325.	137	134	126	475	415	455	365	281	307	155	354	265	260
188.0	350.	350.	350.	144	142	131	491	425	470	386	290	315	165	369	275	280
189.0	375.	375.	375.	152	151	141	510	445	490	405	300	345	176	384	293	296
189.1	375.	375.	375.	155	147	147	520	456	490	405	302	345	181	384	295	294
189.2	375.	375.	375.	155	144	139	526	457	496	415	303	342	186	390	286	285
189.3	375.	375.	375.	155	146	139	530	465	501	419	316	352	197	397	288	288
189.4	375.	375.	375.	156	146	140	532	468	503	420	313	351	197	398	290	288
189.5	375.	375.	375.	153	150	141	536	457	505	424	305	335	197	405	259	300
189.6	375.	375.	375.	158	152	145	536	464	504	425	309	352	202	404	308	307
189.7	375.	375.	375.	159	152	149	537	465	505	425	309	350	194	404	311	310
189.8	375.	375.	375.	159	153	149	540	443	508	425	310	350	195	407	314	311
190.0	400.	400.	400.	166	161	140	552	475	521	445	320	360	205	418	325	325
191.0	425.	425.	425.	166	167	152	571	494	540	470	330	378	213	416	345	342
192.0	450.	450.	450.	175	174	156	590	510	555	494	340	392	225	439	358	359
193.0	475.	475.	475.	183	182	168	615	540	575	515	354	410	243	459	375	375
194.0	500.	500.	500.	198	194	191	650	555	612	555	371	435	264	479	400	400
195.0	300.	300.	300.	150	151	141	540	464	510	455	318	255	206	408	295	292
196.0	400.	400.	400.	176	176	161	600	456	561	455	341	355	237	445	347	350
197.0	450.	450.	450.	186	192	181	630	530	590	525	360	414	254	464	375	379
198.0	500.	500.	500.	196	203	183	665	585	622	565	375	440	275	489	405	410
199.0	525.	525.	525.	207	214	196	700	615	655	603	395	463	295	519	426	432
199.1	525.	525.	525.	215	219	196	710	635	658	610	396	466	300	529	430	460
200.0	550.	550.	550.	275	231	207	750	665	675	645	425	515	315	568	455	485
200.1	550.	550.	550.	357	237	226	780	680	710	730	435	525	346	625	456	500
200.4	550.	550.	550.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
200.2	550.	550.	550.	391	309	271	830	765	760	780	460	508	340	626	745	740
201.0	400.	400.	400.	340	267	228	740	665	675	675	410	515	295	589	645	735
202.0	200.	200.	200.	265	207	171	590	525	540	525	328	410	215	488	478	475
202.1	200.	200.	200.	262	202	169	570	885	541	529	320	461	213	459	463	459
203.0	300.	300.	300.	294	228	193	649	515	600	597	355	445	252	524	535	530
204.0	400.	400.	400.	330	257	221	720	585	662	665	385	500	284	550	615	605
205.0	500.	500.	500.	367	287	256	800	665	730	749	435	560	325	609	698	690
206.0	525.	525.	525.	391	298	263	820	690	750	775	450	575	335	620	725	711
207.0	550.	550.	550.	375	309	271	845	717	772	760	465	592	353	659	754	745
208.0	575.	575.	575.	425	333	283	880	754	804	845	485	625	370	711	820	895
209.0	375.	375.	375.	365	292	251	752	640	700	705	410	540	304	639	669	770
209.1	375.	375.	375.	365	292	241	751	635	699	705	410	540	300	629	667	770
210.0	500.	500.	500.	405	329	271	835	715	770	791	449	590	336	680	756	862
211.0	550.	550.	550.	423	344	283	870	751	801	826	470	615	355	705	796	908
212.0	575.	575.	575.	437	354	293	900	785	835	855	480	640	367	724	825	960
213.0	600.	600.	600.	495	378	318	963	861	902	921	491	738	367	761	886	1230
213.1	600.	600.	600.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
214.0	625.	625.	625.	555	462	443	1070	873	950	955	462	800	418	812	1130	1390
215.0	650.	650.	650.	647	544	523	1130	965	1010	1044	471	870	463	874	1300	1556
216.0	675.	675.	675.	635	634	596	1180	1055	1051	1145	520	945	473	899	1675	1930
217.0	700.	700.	700.	744	757	691	1235	1135	1090	1235	580	1067	485	969	1975	2405
218.0	725.	725.	725.	1132	855	906	1292	1159	1130	1295	570	1070	446	1054	2565	3280
219.0	750.	750.	750.	1405	1119	1123	1310	1185	1140	1375	562	1151	405	1059	3095	4230
220.0	775.	775.	775.	1795	1462	1571	1342	1186	1147	1425	562	1228	250	1139	45CC	4342
221.0	400.	400.	400.	1605	1312	1431	1041	875	881	1100	300	886	43	804	4004	4765
222.0	600.	600.	600.	1725	1412	1531	1195	1025	1000	1270	405	1045	146	955	4260	5071
223.0	750.	750.	750.	1945	1522	1621	1361	1195	1155	1445	501	1170	235	1091	4593	5456
224.0	775.	775.	775.	1955	1642	1781	1380	1220	1174	1480	501	1199	235	1144	5CCC	5936
225.0	800.	800.	800.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
226.0	825.	825.	825.	2645	2232	2461	1452	1245	1220	1666	425	1540	140	1204	6880	8130
227.0	850.	850.	850.	-55	-88	-129	-240	-495	50	-355	-380	-250	-395	-61	-245	-430
228.0	557.	557.	557.	2885	2472	2751	1060	867	821	1135	211	1520	70	1014	7645	8840
229.0	543.	543.	543.	2845	2462	2741	1050	860	810	1120	205	1500	66	1007	7626	8812
230.0	600.	600.	600.	2905	2492	2771	1060	875	820	1165	250	1571	116	1087	7686	8885
231.0	659.	659.	659.	2945	2532	2821	1080	896	830	1145	310	1670	176	1180	7755	8961
232.0	710.	710.	710.	2981	2567	2836	1101	904	851	1165	345	1729	220	1235	7E36	9050
233.0	600.	825.	825.	3135	2712	2971	1075	936	830	1140	438	1865	305	1355	8117	9365
234.0	600.	850.	850.	3255	2812	3106	1045	915	800	1115	470	1925	347	1428	8353	9650
235.0	600.	875.	875.	3505	3042	3331	990	850	750	1055	470	1991	370	1519	8865	1C190
236.0	600.	900.	900.	3865	3342	3613	915	780	673	1000	430	2082	425	1755	9550	11062
237.0	600.	925.	925.	4360	3732	4141	845	710	571	915	190	2260	430	1965	11765	12810

STAGE	CNTR	RCTR	CRNR	27	28	29	30	31	32	33	34	35	36	37
1.0	75.	75.	75.	-35	-41	5	-40	-65	-17	-89	-70	60	-55	C
2.0	100.	100.	100.	-21	-21	3	-20	-40	25	-52	125	60	-55	C
3.0	125.	125.	125.	-4	-11	110	10	-10	25	1	395	52	-50	C
4.0	150.	150.	150.	12	9	61	40	21	47	51	290	40	-50	C
5.0	175.	175.	175.	30	29	95	60	50	80	98	-30	30	-50	C
6.0	200.	200.	200.	40	45	128	95	80	105	152	325	10	-48	C
7.0	225.	225.	225.	61	69	162	123	115	133	204	630	-10	-46	C
7.1	225.	225.	225.	-720	-541	-880	-290	-65	-595	-234	-3060	-5060	-86	C
7.2	225.	225.	225.	-720	-541	-880	-290	-65	-595	-234	-3060	-5060	-86	C
8.0	200.	200.	200.	42	54	120	100	100	110	205	1090	-25	-48	C
9.0	150.	150.	150.	25	29	70	60	55	75	136	550	-25	-48	C
10.0	75.	75.	75.	-15	-15	20	-2	-7	15	26	-185	10	-48	C
13.0	75.	75.	75.	10	0	22	-8	5	15	6	-180	17	-15	C
14.0	100.	100.	100.	26	17	33	23	25	75	37	-172	17	-15	C
15.0	125.	125.	125.	40	29	58	45	46	40	51	-130	17	-15	C
16.0	150.	150.	150.	50	42	75	65	67	65	86	92	5	-15	C
17.0	175.	175.	175.	62	56	100	85	95	87	124	160	2	-13	C
18.0	200.	200.	200.	75	69	120	105	115	115	155	382	-10	-11	C
19.0	225.	225.	225.	89	79	146	125	140	128	196	382	-13	-11	C
20.0	200.	200.	200.	79	70	125	110	120	127	166	385	-15	-10	C
21.0	175.	175.	175.	69	59	102	90	100	127	131	361	-10	-8	C
22.0	125.	125.	125.	45	37	60	52	58	127	64	265	-15	-8	C
23.0	75.	75.	75.	21	9	30	8	15	90	-9	5	-10	-11	C
26.0	75.	75.	75.	20	9	30	5	10	90	-11	-60	5	-11	C
27.0	100.	75.	100.	35	22	30	-2	8	90	24	-60	5	-8	C
28.0	125.	75.	125.	48	39	10	-10	5	90	59	-57	C	-8	C
29.0	150.	75.	150.	60	46	0	-1	5	80	96	-20	C	-6	C
30.0	175.	75.	175.	70	64	20	-5	5	75	136	-10	C	C	C
31.0	200.	75.	200.	85	79	20	-9	5	75	174	-5	C	C	C
32.0	225.	75.	225.	100	92	20	-10	5	75	211	45	C	C	C
33.0	200.	75.	200.	88	79	19	-2	5	67	176	125	C	C	C
34.0	175.	75.	175.	75	69	0	-2	5	63	144	127	-10	C	C
35.0	150.	75.	150.	60	56	0	0	5	63	106	125	-10	C	C
36.0	125.	75.	125.	50	44	0	0	5	65	71	100	-10	C	C
37.0	100.	75.	100.	37	29	0	0	5	65	36	-40	-10	12	C
38.0	75.	75.	75.	20	14	0	1	5	66	-4	-105	-10	12	C
51.0	75.	75.	75.	0	0	0	0	0	0	0	0	C	C	C
52.0	75.	100.	75.	10	0	20	25	25	25	2	C	5	C	C
53.0	75.	125.	75.	10	0	42	45	45	47	0	C	5	C	C
54.0	75.	150.	75.	10	0	70	70	70	67	-1	10	10	C	C
55.0	75.	175.	75.	8	-1	105	90	95	95	-4	10	10	C	C
56.0	75.	200.	75.	8	-1	120	112	116	115	-4	10	10	C	C
57.0	75.	225.	75.	5	-1	122	133	145	135	-6	10	10	C	C
58.0	75.	200.	75.	5	-1	122	115	125	115	-4	55	10	-6	C
59.0	75.	175.	75.	10	-1	100	95	100	95	-4	55	10	-6	C
60.0	75.	150.	75.	10	-1	78	73	76	73	-4	50	10	-6	C
61.0	75.	125.	75.	-8	-1	55	52	55	50	-6	-75	10	-6	C
63.0	75.	75.	75.	12	4	9	10	8	5	-5	-80	10	-6	C
1.4	75.	75.	75.	13	4	5	8	7	5	-4	-80	10	-6	C
2.4	100.	100.	100.	20	17	30	28	30	25	27	-75	10	-6	C
3.4	125.	125.	125.	35	29	50	45	50	45	65	-70	10	-6	C
4.4	150.	150.	150.	50	39	70	65	75	65	116	-30	5	-6	C
5.4	175.	175.	175.	60	54	98	85	95	90	136	105	5	-6	C
6.4	200.	200.	200.	70	67	120	105	115	115	174	175	5	-10	C
7.4	225.	225.	225.	82	79	122	122	138	135	214	259	-20	-10	C
8.4	200.	200.	200.	75	69	120	105	118	115	181	270	-25	-10	C
9.4	175.	175.	175.	62	59	100	90	97	95	146	271	-20	-10	C
10.4	150.	150.	150.	55	47	78	70	75	75	111	270	-20	-10	C
11.4	125.	125.	125.	40	29	52	50	55	50	76	245	-25	-10	C
12.4	100.	100.	100.	30	19	30	29	35	27	38	129	-10	-10	C
13.4	75.	75.	75.	15	4	9	8	5	5	6	-10	-10	-10	C
76.0	75.	75.	75.	10	-1	9	5	5	5	6	-25	C	-10	C
77.0	125.	125.	125.	29	24	50	52	58	50	81	-20	C	-10	C
77.1	150.	150.	150.	50	39	71	70	76	70	116	-5	C	-10	C
78.0	175.	175.	175.	62	54	100	88	95	95	147	75	C	-10	C
78.1	200.	200.	200.	75	67	120	105	115	115	186	295	C	-10	C
79.0	225.	225.	225.	85	79	122	125	140	136	221	317	C	-5	C

STAGE	CNTR	RCTR	CRNR	27	28	29	30	31	32	33	34	35	36	37
80.0	250.	250.	250.	100	94	172	150	170	165	268	430	C	C	C
81.0	275.	275.	275.	115	110	209	190	200	196	322	619	-20	C	C
82.0	300.	300.	300.	131	129	240	220	225	245	391	740	-20	C	C
83.0	325.	325.	325.	150	147	275	250	265	270	456	1030	-40	C	C
84.0	350.	350.	350.	169	164	320	295	305	335	541	1337	-95	C	C
84.1	350.	350.	350.	170	169	330	303	315	325	555	1415	-100	C	C
84.2	350.	350.	350.	-720	-541	-880	-290	-65	-595	-234	-3060	-110	C	C
85.0	375.	375.	375.	185	184	365	335	345	403	616	1480	-100	C	C
86.0	350.	350.	350.	170	172	345	319	330	398	596	1485	-100	C	C
87.0	325.	325.	325.	169	159	325	300	307	315	559	1485	-100	C	C
88.0	300.	300.	300.	155	149	305	280	285	295	526	1485	-100	C	C
89.0	275.	275.	275.	145	139	280	260	265	275	489	1280	-100	C	C
90.0	250.	250.	250.	130	129	260	240	237	255	481	1280	-100	C	C
91.0	225.	225.	225.	120	114	235	223	218	230	471	1280	-100	C	C
91.1	200.	200.	200.	110	104	212	205	196	210	444	1195	-100	C	C
92.0	175.	175.	175.	98	89	190	185	175	185	396	1090	-100	C	C
92.1	150.	150.	150.	86	79	170	163	155	165	366	939	-80	C	C
93.0	125.	125.	125.	75	67	145	142	130	143	326	789	-30	C	C
94.0	75.	75.	75.	50	39	100	105	85	95	255	791	-30	C	C
95.0	75.	75.	75.	42	31	88	95	74	90	184	825	22	-10	C
95.1	125.	125.	125.	70	56	135	135	117	135	256	845	5	-10	C
96.0	175.	175.	175.	90	79	182	187	164	175	326	1126	-20	-10	C
96.1	225.	225.	225.	111	108	230	227	207	225	-234	1460	-50	-10	C
97.0	275.	275.	275.	135	133	278	262	250	265	479	1602	-65	-6	C
97.1	325.	325.	325.	162	154	325	308	298	313	562	1760	-75	-6	C
97.2	350.	350.	350.	175	169	350	330	325	335	606	1825	-80	-6	C
98.0	375.	375.	375.	188	179	380	352	345	360	686	2010	-90	-6	C
99.0	375.	325.	325.	169	159	340	320	310	325	771	2020	-110	-6	C
100.0	375.	275.	275.	143	137	292	280	267	285	769	2015	-110	-6	C
100.1	375.	275.	275.	143	137	292	280	267	285	814	2000	-110	-6	C
101.0	375.	225.	225.	119	109	246	242	255	245	826	2000	-110	-6	C
102.0	375.	175.	175.	96	84	200	202	185	201	838	1980	-110	-6	C
102.1	375.	150.	150.	81	73	178	183	164	177	846	1915	-110	-6	C
103.0	375.	125.	125.	70	59	155	162	145	156	856	1840	-110	-6	C
103.1	375.	100.	100.	60	48	130	141	124	135	866	1790	-90	-6	C
104.0	375.	75.	75.	42	31	105	121	95	114	871	1787	-90	-6	C
105.0	325.	75.	75.	45	31	105	121	95	110	798	1752	-90	-6	C
106.0	275.	75.	75.	45	31	103	120	95	107	716	1590	-90	-6	C
107.0	225.	75.	75.	49	35	103	120	94	105	633	1445	-90	-6	C
108.0	150.	75.	75.	50	39	100	120	87	102	496	1010	-70	-6	C
109.0	75.	75.	75.	51	39	100	120	85	95	356	1010	-50	-6	C
114.0	75.	75.	75.	50	39	100	120	85	100	338	705	-10	C	-10
115.0	125.	75.	125.	72	67	100	120	86	100	424	705	-10	C	-10
116.0	175.	75.	175.	105	95	98	118	85	100	506	1055	-10	C	-110
117.0	225.	75.	225.	135	119	99	112	85	100	587	1210	-10	C	-120
118.0	250.	75.	250.	150	137	98	110	84	97	629	1395	-40	C	-150
119.0	275.	75.	275.	162	151	98	108	84	102	675	1407	-40	C	-150
120.0	300.	75.	300.	180	169	98	108	84	97	717	1457	-50	C	-150
121.0	325.	75.	325.	192	181	95	101	80	95	765	1535	-60	C	-170
122.0	350.	75.	350.	208	199	91	100	77	95	-234	1540	-60	C	-180
123.0	375.	75.	375.	220	216	91	98	76	95	866	1590	-70	C	-195
123.1	400.	75.	400.	239	229	90	96	75	95	921	1682	-70	C	-240
123.2	375.	75.	375.	226	219	90	99	75	96	887	1695	-70	C	-240
123.3	375.	75.	375.	230	219	90	100	80	96	896	1725	-100	C	-330
124.0	350.	75.	350.	219	209	90	98	75	95	861	1725	-100	C	-330
125.0	325.	75.	325.	207	199	90	100	78	96	821	1715	-100	C	-330
126.0	300.	75.	300.	193	182	90	100	77	95	781	1715	-100	C	-330
127.0	275.	75.	275.	180	169	95	103	80	98	742	1665	-100	C	-330
128.0	250.	75.	250.	170	159	92	105	80	97	690	1640	-100	C	-330
129.0	225.	75.	225.	155	144	91	105	81	96	659	1535	-90	C	-370
130.0	175.	75.	175.	130	117	98	110	85	100	576	1376	-75	C	-370
131.0	125.	75.	125.	102	89	99	113	85	101	487	1180	-60	C	-370
132.0	75.	75.	75.	73	59	103	120	90	104	396	990	-40	C	-370
133.0	75.	75.	75.	52	39	96	113	84	97	391	990	-40	C	-370
134.0	75.	125.	75.	53	39	122	158	130	143	394	990	-15	C	-370
135.0	75.	175.	75.	50	34	192	200	175	187	391	1030	-20	C	-381
136.0	75.	225.	75.	49	31	242	253	225	235	389	1140	-20	C	-381

STAGE	CNTR	XCTR	CRNR	27	28	29	30	31	32	33	34	35	36	37
137.0	75.	250.	75.	45	29	270	268	246	257	387	1220	-20	0	-381
137.1	200.	250.	200.	109	98	268	263	245	256	586	1390	-40	0	-381
138.0	200.	275.	200.	110	99	320	281	266	285	596	1646	-35	0	-381
139.0	200.	300.	200.	110	99	320	320	294	308	596	1656	-60	0	-380
140.0	200.	325.	200.	108	99	343	330	316	329	596	1675	-60	0	-380
141.0	200.	350.	200.	106	97	370	358	345	355	596	1705	-60	0	-380
142.0	200.	375.	200.	101	94	400	402	367	378	596	1720	-60	0	-380
142.1	200.	375.	200.	101	94	410	410	375	384	596	1740	-70	0	-380
142.2	175.	375.	175.	90	79	415	420	388	384	559	1750	-70	0	-380
142.3	150.	375.	150.	75	69	417	415	390	385	524	1760	-65	-6	-150
143.0	150.	350.	150.	79	67	395	396	367	365	521	1760	-80	-6	-150
144.0	150.	325.	150.	80	68	390	370	355	340	517	1760	-80	-6	-150
145.0	150.	300.	150.	80	69	361	350	325	317	517	1760	-80	-6	-150
146.0	150.	275.	150.	80	71	340	330	295	400	516	1740	-80	-6	-150
147.0	150.	250.	150.	83	71	315	309	274	277	516	1695	-80	-6	-150
147.1	75.	250.	75.	32	29	320	316	280	280	386	1475	-80	-6	-150
148.0	75.	225.	75.	40	34	295	291	255	257	388	1417	-80	0	-150
149.0	75.	175.	75.	40	35	243	250	207	210	384	1305	-60	0	-150
150.0	75.	125.	75.	42	28	190	201	163	165	386	1130	-45	0	-150
151.0	75.	75.	75.	60	34	140	152	113	117	387	1000	-40	0	-150
152.0	75.	75.	75.	46	35	129	148	103	113	386	1000	-59	-6	-147
152.1	125.	125.	125.	70	64	175	190	145	155	471	1040	-25	-6	-148
153.0	175.	175.	175.	90	93	220	230	194	200	554	1395	-50	-6	-145
154.1	225.	225.	225.	116	110	270	270	235	245	637	1630	-50	-6	-145
154.0	275.	275.	275.	140	138	320	310	280	287	726	1720	-60	-6	-106
154.1	300.	300.	300.	152	149	340	292	305	309	771	1880	-75	-6	-110
154.2	325.	325.	325.	166	156	370	275	335	335	836	1930	-98	0	-78
154.3	350.	350.	350.	180	174	400	301	356	365	916	1945	-105	0	-78
155.0	375.	375.	375.	190	188	430	330	385	391	976	1960	-110	0	-78
156.0	400.	400.	400.	210	209	472	362	425	420	1086	2027	-120	0	-76
156.1	400.	400.	400.	221	214	493	381	444	437	1137	2055	-160	0	-67
157.0	425.	425.	425.	231	234	536	420	475	474	1251	2145	-160	0	-67
158.0	450.	450.	450.	242	273	732	672	727	725	2166	3116	-230	-26	55
159.0	425.	425.	425.	260	275	720	665	725	720	2155	3295	-245	-25	62
160.0	400.	400.	400.	265	241	702	642	700	695	2145	3295	-245	-30	62
161.0	375.	375.	375.	252	248	690	620	676	674	2091	3295	-245	-25	62
161.1	375.	375.	375.	252	248	676	620	676	674	2091	3275	-245	-26	62
161.2	375.	375.	375.	255	251	684	626	685	679	2105	3273	-248	-25	60
161.3	375.	375.	375.	265	259	699	638	695	692	2126	3276	-245	-20	60
161.4	375.	375.	375.	280	269	709	645	696	697	2096	3280	-245	-30	225
161.5	375.	375.	375.	280	266	700	645	697	697	2059	3280	-245	-30	125
162.0	350.	350.	350.	270	259	671	625	676	675	2054	3280	-245	-30	125
163.0	325.	325.	325.	246	239	650	605	655	655	2000	3277	-250	-30	125
164.0	275.	275.	275.	233	220	600	610	605	604	1886	3090	-250	-30	125
165.0	225.	225.	225.	209	194	545	560	555	550	1768	2860	-225	-30	125
166.0	175.	175.	175.	180	164	487	500	496	495	1637	2540	-193	-30	125
167.0	125.	125.	125.	150	125	428	455	445	479	1506	2215	-168	-30	125
168.0	75.	75.	75.	121	99	367	399	385	390	1361	1850	-135	-30	125
169.0	125.	125.	125.	141	121	419	440	435	423	1487	1860	-135	-30	125
170.0	175.	175.	175.	169	138	471	382	483	474	1606	1975	-135	-30	125
171.0	225.	225.	225.	190	177	508	432	535	525	1736	2285	-140	-30	125
171.1	225.	225.	225.	195	178	531	436	535	533	1741	2420	-155	-25	125
172.0	250.	225.	225.	198	179	533	433	545	535	1816	2460	-160	-21	125
173.0	275.	225.	225.	200	179	533	437	545	535	1881	2567	-160	-25	125
174.0	300.	225.	225.	200	180	532	445	546	536	1937	2582	-165	-26	125
175.0	325.	225.	225.	199	178	533	440	546	540	1996	2621	-165	-26	125
176.0	350.	225.	225.	197	178	536	440	546	543	2068	2621	-165	-26	125
177.0	375.	225.	225.	195	179	535	440	546	543	2137	2720	-173	-26	125
178.0	350.	225.	225.	195	179	535	440	545	540	2085	2790	-180	-26	125
179.0	325.	225.	225.	198	179	535	440	545	540	2036	2790	-180	-26	125
180.0	300.	225.	225.	199	181	535	440	545	540	1976	2790	-180	-26	125
181.0	275.	225.	225.	200	181	533	500	545	540	1916	2790	-180	-26	130
182.0	250.	225.	225.	201	182	532	500	545	536	1835	2790	-180	-26	130
183.0	225.	225.	225.	205	185	531	500	545	536	1776	2785	-180	-26	130
183.1	225.	225.	225.	209	188	531	500	545	535	1776	-3060	-5060	-26	130
184.0	250.	250.	250.	217	196	552	520	565	555	1826	2790	-183	-26	130
185.0	275.	275.	275.	229	209	575	542	595	584	1881	2790	-183	-26	130

STAGE	CNTR	XCTR	CRNR	27	28	29	30	31	32	33	34	35	36	37
186.0	300.	300.	300.	240	222	612	575	617	607	1939	2790	-180	-20	130
187.0	325.	325.	325.	255	234	640	590	645	635	2001	2805	-185	-20	130
188.0	350.	350.	350.	269	245	670	620	675	665	2068	2940	-150	-20	130
189.0	375.	375.	375.	282	269	700	648	705	694	2139	2955	-155	-20	130
189.1	375.	375.	375.	285	269	710	639	710	701	2166	3111	-223	-25	125
189.2	375.	375.	375.	274	264	709	639	710	703	2184	3120	-227	-21	110
189.3	375.	375.	375.	276	268	718	646	719	712	2205	3156	-230	-21	110
189.4	375.	375.	375.	277	268	721	649	732	715	2217	3287	-248	-24	117
189.5	375.	375.	375.	283	276	731	654	730	724	2225	3296	-251	-2	72
189.6	375.	375.	375.	292	284	738	653	735	727	2231	3330	-256	-8	-7
189.7	375.	375.	375.	295	287	740	660	737	730	2235	3330	-257	-8	-7
189.8	375.	375.	375.	300	282	742	665	744	735	2247	3346	-257	-6	-138
190.0	400.	400.	400.	310	301	770	690	770	760	2312	3346	-255	-6	-140
191.0	425.	425.	425.	330	316	802	720	805	790	2398	3455	-259	-2	-150
192.0	450.	450.	450.	344	323	833	750	835	820	2481	3525	-260	-6	-173
193.0	475.	475.	475.	360	349	870	788	870	857	2596	3630	-265	-36	-203
194.0	500.	500.	500.	383	372	920	840	924	907	2746	3840	-273	-2	-203
195.0	300.	300.	300.	296	269	720	653	727	711	2307	3660	-278	-10	-203
196.0	400.	400.	400.	343	319	820	748	836	810	2540	3695	-275	-10	-203
197.0	450.	450.	450.	370	344	874	791	877	863	2666	3690	-275	-10	-203
198.0	500.	500.	500.	400	369	940	858	935	922	2817	3840	-278	-10	-203
199.0	525.	525.	525.	420	383	990	900	986	967	2996	3918	-281	-8	-201
199.1	525.	525.	525.	420	401	1030	903	1000	976	3055	4110	-280	-8	-200
200.0	550.	550.	550.	465	424	1109	952	1084	1027	3266	4326	-295	-15	-200
200.1	550.	550.	550.	773	667	1136	985	1360	1065	3861	4450	-315	-20	-325
200.4	550.	550.	550.	-720	-541	-880	-290	-65	-595	-234	-3060	-5060	-860	-325
200.5	550.	550.	550.	900	702	1435	1002	1470	1125	4334	5000	-360	-32	-325
201.0	600.	600.	600.	700	605	1255	860	1295	975	3978	4740	-360	-30	-337
202.0	200.	200.	200.	530	439	973	640	1023	735	3261	3700	-345	-30	-337
202.1	200.	200.	200.	515	429	954	620	1008	720	3236	3416	-260	-35	-335
203.0	300.	300.	300.	588	451	1081	715	1127	826	3527	3725	-270	-35	-335
204.0	400.	400.	400.	670	549	1220	822	1260	943	3879	4322	-305	-35	-335
205.0	500.	500.	500.	753	645	1370	937	1406	1055	4276	4867	-331	-31	-335
206.0	525.	525.	525.	790	675	1416	970	1453	1103	4413	4980	-355	-30	-189
207.0	550.	550.	550.	810	704	1474	1010	1505	1140	4586	4620	-355	-30	-65
208.0	575.	575.	575.	975	788	1550	1100	1630	1195	4849	4810	-373	-30	67
209.0	375.	375.	375.	734	619	1318	961	1407	985	4201	4800	-380	-30	110
209.1	375.	375.	375.	732	619	1315	961	1405	982	4207	4800	-379	-29	110
210.0	500.	500.	500.	922	760	1472	1039	1560	1115	4685	4755	-380	-33	120
211.0	550.	550.	550.	861	738	1540	1092	1633	1168	4868	4860	-380	-33	160
212.0	575.	575.	575.	898	761	1590	1280	1690	1205	5026	4905	-380	-33	150
213.0	600.	600.	600.	1242	785	2050	1924	1802	1287	5586	5230	-410	-40	220
213.1	600.	600.	600.	-720	-541	-880	-290	-65	-595	-234	-3060	-5060	-860	220
214.0	625.	625.	625.	1470	1179	2370	2130	1965	1815	6316	5630	-460	-50	275
215.0	650.	650.	650.	1930	1394	2709	2605	2486	2073	7056	6025	-460	-60	282
216.0	675.	675.	675.	2250	1749	3330	2880	2735	2540	7881	6360	-510	-88	240
217.0	700.	700.	700.	2770	2074	3855	3390	3385	3054	8931	6530	-530	-85	240
218.0	725.	725.	725.	3338	2574	4410	4220	3815	3775	10076	6720	-520	-85	240
219.0	750.	750.	750.	3340	3134	5422	5158	4465	4406	11344	6725	-520	-140	240
220.0	775.	775.	775.	5230	4279	6490	6330	5428	5495	13167	6725	-520	-90	240
221.0	400.	400.	400.	4529	3764	5652	5330	4614	4718	11196	5230	-380	-90	240
222.0	600.	600.	600.	4333	4039	6160	5793	5113	5207	12245	5520	-430	-80	240
223.0	750.	750.	750.	4341	4394	6712	6380	5615	5755	13726	6540	-490	-80	240
224.0	775.	775.	775.	5751	4799	7160	6840	5975	6170	15646	6570	-490	-80	240
225.0	800.	800.	800.	-720	-541	-880	-290	-65	-595	16239	-3060	-5060	-860	240
226.0	825.	825.	825.	7630	6879	9230	8882	7535	7775	18739	6650	-460	-80	240
227.0	850.	850.	850.	-720	-541	-880	-290	-65	-595	-26797	-3060	-5060	-860	240
228.0	557.	557.	557.	8091	7169	9775	9150	7688	7995	-16770	5200	-260	-80	240
229.0	543.	543.	543.	8070	7139	9750	9126	7665	7966	-17770	5090	-250	-80	240
229.0	600.	600.	600.	8130	7159	9955	9290	7955	8140	-13270	5060	-250	-80	240
231.0	659.	659.	659.	8301	7276	10285	9591	8390	8385	-8270	5067	-250	-70	245
232.0	710.	710.	710.	8290	7350	10603	9871	8698	8655	-7840	5102	-260	-70	245
233.0	600.	825.	825.	8630	7654	11590	10925	9855	9635	-6340	5142	-250	-70	246
234.0	600.	850.	850.	8965	7929	12118	11470	10395	10125	-6040	5142	-250	-70	246
235.0	600.	875.	875.	9400	8283	12970	12536	11365	10305	-6040	5125	-250	-60	246
236.0	600.	900.	900.	11222	9455	14270	12808	12455	11528	-6040	4960	-225	-60	246
237.0	600.	925.	925.	12950	10668	16150	16160	13985	12083	-6040	4890	-160	-60	240

D.2 REACTIONS

At each Load Stage readings of the 16 load cells were taken. These were converted to reaction values in pounds according to the calibration curve (taken as a straight line) for each cell. The following tabulation gives the reactions at the 16 reaction points as shown in Figure D.2. The first four columns are the same as in the table of deflections. The ratio shown in the righthand column is the ratio of the sum of measured reactions to the sum of self weight and nominal applied load.

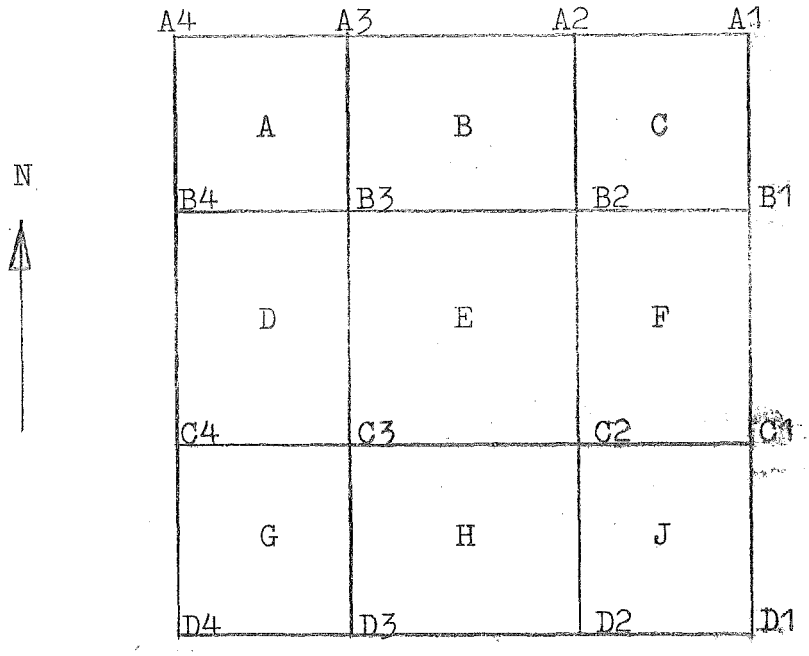


FIGURE D.2. REACTION POINT LOCATION.

STAGE	CNTR	RCTR	CRNR	C3	C2	B2	B3	A2	A3	C4	B4	C1	B1	C2	C3	D1	A4	A1	C4	RATIC
1.0	75.	75.	75.	2691	2661	2722	2644	1038	1003	1020	1011	994	993	965	1008	251	253	262	254	0.964
2.0	100.	100.	100.	3296	3277	3327	3230	1258	1192	1237	1211	1202	1215	1151	1208	293	301	308	298	0.950
3.0	125.	125.	125.	3912	3892	3782	3734	1508	1391	1456	1421	1434	1442	1341	1424	335	349	352	342	0.944
4.0	150.	150.	150.	4508	4509	4287	4558	1728	1580	1671	1621	1656	1674	1526	1730	385	403	400	396	0.939
5.0	175.	175.	175.	5124	5153	4821	5213	1978	1769	1904	1831	1868	1911	1716	1845	437	459	448	446	0.935
6.0	200.	200.	200.	5700	5769	5326	5817	2197	1958	2116	2037	2076	2136	1901	2046	491	512	494	501	0.929
7.0	225.	225.	225.	6295	6405	5881	6461	2407	2127	2336	2242	2267	2370	2087	2236	546	564	549	557	0.926
7.1	225.	225.	225.	6335	6425	5900	6491	2417	2107	2343	2242	2267	2370	2087	2211	546	564	547	555	0.928
7.2	225.	225.	225.	6315	6464	5930	6501	2407	2097	2348	2232	2257	2339	2077	2206	550	564	547	561	0.927
8.0	200.	200.	200.	5670	5819	5316	5877	2207	1898	2126	2022	2045	2128	1886	2001	504	526	496	511	0.928
9.0	150.	150.	150.	4478	4568	4128	4638	1798	1530	1702	1601	1646	1764	1516	1594	407	445	404	414	0.938
10.0	75.	75.	75.	2691	2701	2435	2755	1178	964	1050	995	1025	1059	956	972	267	289	262	272	0.969
11.0	75.	75.	75.	2611	2581	2732	2576	1018	964	1025	1026	974	1053	956	997	297	303	274	292	0.958
12.0	100.	100.	100.	3237	3217	3336	3211	1218	1153	1227	1236	1171	1235	1136	1193	335	337	314	338	0.946
13.0	125.	125.	125.	3862	3882	3900	3925	1438	1351	1444	1441	1383	1447	1321	1399	381	379	358	380	0.940
14.0	150.	150.	150.	4478	4478	4475	4440	1658	1540	1651	1646	1580	1654	1501	1594	423	423	400	424	0.932
15.0	175.	175.	175.	5134	5153	5079	5074	1868	1736	1873	1861	1787	1870	1686	1793	467	465	446	468	0.919
16.0	200.	200.	200.	5759	5777	5653	5698	2097	1938	2075	2072	1994	2077	1871	1992	510	510	490	515	0.925
17.0	225.	225.	225.	6405	6405	6207	6333	2277	2127	2287	2272	2207	2304	2062	2191	556	554	535	556	0.923
18.0	200.	200.	200.	5809	5769	5623	5748	2077	1948	2075	2057	2015	2102	1881	1990	504	514	484	507	0.930
19.0	175.	175.	175.	5203	5134	5019	5123	1878	1749	1863	1846	1808	1901	1696	1790	473	471	434	456	0.933
20.0	125.	125.	125.	3972	3872	3831	3914	1458	1371	1429	1426	1409	1477	1321	1389	353	381	332	354	0.943
21.0	75.	75.	75.	2730	2641	2702	2675	1038	974	1015	1011	1000	1033	946	982	257	273	238	258	0.964
22.0	75.	75.	75.	2760	2611	2693	2705	1058	984	1016	1011	1010	1053	956	982	257	263	230	248	0.966
23.0	100.	75.	100.	2929	2820	2900	2923	1088	1022	1050	1046	1050	1099	995	1018	329	335	316	338	0.929
24.0	125.	75.	125.	3376	3157	3247	3300	1208	1123	1151	1156	1151	1210	1096	1113	407	411	396	416	0.942
25.0	150.	75.	150.	3884	3515	3524	3617	1278	1192	1227	1226	1222	1285	1161	1188	489	493	478	498	0.938
26.0	175.	75.	175.	4011	3933	3821	3924	1358	1272	1303	1301	1363	1366	1236	1258	570	576	563	585	0.932
27.0	200.	75.	200.	4349	4177	4128	4271	1458	1351	1378	1381	1433	1457	1314	1344	650	658	641	665	0.934
28.0	225.	75.	225.	4657	4468	4415	4588	1538	1421	1466	1456	1464	1477	1381	1405	731	740	727	747	0.928
29.0	200.	75.	200.	4409	4220	4178	4321	1478	1381	1419	1401	1414	1477	1331	1364	642	664	633	657	0.944
30.0	175.	75.	175.	4061	3882	3871	3994	1378	1292	1333	1316	1328	1396	1256	1278	558	636	551	573	0.946
31.0	150.	75.	150.	3743	3574	3584	3686	1298	1212	1257	1246	1257	1311	1191	1213	473	514	466	490	0.951
32.0	125.	75.	125.	3336	3227	3267	3330	1218	1133	1166	1156	1166	1220	1111	1128	353	425	386	408	0.949
33.0	100.	75.	100.	3088	2939	2990	3062	1128	1073	1086	1086	1090	1144	1055	1058	309	330	302	322	0.960
34.0	75.	75.	75.	2770	2621	2693	2725	1048	994	1015	1006	1015	1055	970	982	230	253	224	242	0.968
35.0	75.	75.	75.	2532	2492	2603	2556	1048	994	1045	1036	1015	1064	985	1038	319	309	298	318	0.958
36.0	75.	100.	75.	2869	2820	2920	2893	1188	1123	1181	1176	1141	1200	1116	1168	283	279	254	286	0.961
37.0	75.	125.	75.	3187	3138	3227	3230	1318	1222	1308	1301	1282	1321	1231	1293	242	248	214	246	0.958
38.0	75.	150.	75.	3495	3465	3554	3518	1458	1351	1434	1431	1358	1457	1246	1414	202	214	174	208	0.953
39.0	75.	175.	75.	3783	3763	3793	3795	1598	1481	1565	1561	1459	1461	1356	1529	174	161	130	156	0.953
40.0	75.	200.	75.	4111	4071	4079	4112	1718	1600	1696	1701	1656	1714	1571	1659	120	124	96	126	0.945
41.0	75.	225.	75.	4419	4389	4356	4410	1838	1729	1818	1826	1772	1845	1686	1785	80	80	60	86	0.941
42.0	75.	200.	75.	4131	4091	4079	4122	1708	1610	1696	1696	1656	1715	1566	1654	110	110	90	118	0.945
43.0	75.	175.	75.	3853	3803	3801	3865	1588	1491	1576	1566	1525	1593	1456	1534	142	146	124	148	0.951
44.0	75.	150.	75.	3575	3535	3528	3611	1458	1371	1455	1441	1394	1468	1346	1404	172	180	154	180	0.951
45.0	75.	125.	75.	3237	3187	3227	3221	1318	1252	1303	1296	1267	1321	1216	1273	202	200	180	202	0.953
46.0	75.	75.	75.	2631	2581	2663	2646	1068	1003	1056	1036	1015	1064	985	1023	265	273	252	272	0.967
1.4	75.	75.	75.	2631	2581	2653	2626	1068	1013	1056	1036	1020	1069	980	1023	263	269	254	268	0.965
2.4	100.	100.	100.	3267	3217	3237	3260	1278	1212	1262	1246	1227	1285	1176	1228	307	313	300	318	0.956
3.4	125.	125.	125.	3912	3833	3801	3875	1488	1411	1465	1456	1434	1497	1361	1424	353	357	348	364	0.946
4.4	150.	150.	150.	4528	4458	4386	4459	1698	1610	1676	1661	1636	1705	1546	1624	399	405	394	410	0.940
5.4	175.	175.	175.	5173	5104	4980	5123	1898	1799	1895	1876	1838	1921	1736	1825	445	451	442	456	0.936
6.4	200.	200.	200.	5789	5729	5584	5738	2207	1958	2106	2082	2045	2128	1921	2021	491	497	488	503	0.935
7.4	225.	225.	225.	6405	6365	6179	6362	2297	2186	2318	2287	2247	2334	2102	2211	538	546	539	551	0.929
8.4	200.	200.	200.	5779	5729	5584	5758	2107	1988	2106	2077	2040	2123	1921	2016	489	504	488	503	0.932
9.4	175.	175.	175.	5173	5124	5000	5153	1898	1799	1858	1871	1838	1921	1731	1825	443	463	442	450	0.938
10.4	150.	150.	150.	4548	4488	4396	4539	1698	1610	1681	1661	1636	1705	1541	1624	395	421	394	404	0.947
11.4	125.	125.	125.	3922	3872	3811	3914	1488	1411	1465	1451	1434	1497	1356	1424	345	371	346	358	0.949
12.4	100.	100.	100.	3277	3237	3227	3280	1268	1212	1257	1241	1222	1275	1166	1223	299	320	298	308	0.963
13.4	75.	75.	75.	2661	2621	2663	2666	1058	1013	1046	1031	1015	1064	975	1018	257	277	256	266	0.969
76.0	75.	75.	75.	2601	2552	2643	2626	1038	1013	1035	1031	1005	1043	975	1023	253	301	300	300	0.965
77.0	125.	125.	125.	3872	3783	3801	3875	1468	1401	1446	1441	1434	1472	1361	1429	393	377	376	392	0.944
77.1	150.	150.	150.	4508	4428	4396	4509	1698	1590	1656	1636	1631	1669	1531	1614	429	415	406	434	0.937
78.0	175.	175.	175.	5143	5084	5019	5133	1908	1759	1873	1851	1828	1880	1716	1810	469	467	448	478	0.934
78.1	200.	200.	200.	5779	5719	5613	5758	2107	1958	2080	2062	2030	2097	1906	2006	512	514	494	523	0.931
79.0	225.	225.	225.	6405	6375	6188	6362	2307	2147	2287	2272	2227	2304	2087	2196	560	562	543	571	0.927

STAGE	CNTR	RCTR	CRNR	C3	C2	B2	B3	A2	A3	C4	B4	C1	B1	C2	C3	D1	A4	A1	C4	RATIC
80.0	250.	250.	250.	7000	7000	6732	6987	2517	2326	2515	2482	2434	2531	2267	2407	600	610	587	613	0.924
81.0	275.	275.	275.	7626	7636	7287	7591	2537	2544	2727	2692	2646	2748	2467	2607	644	654	637	657	0.915
82.0	300.	300.	300.	8262	8231	7871	8275	2937	2733	2898	2852	2803	2929	2647	2808	695	700	689	701	0.920
83.0	325.	325.	325.	8917	8967	8445	8889	3146	2921	3096	3068	2994	3151	2836	3014	736	744	739	746	0.919
84.0	350.	350.	350.	9543	9662	9059	9583	3326	3091	3277	3243	3191	3308	2972	3194	783	789	793	789	0.917
84.1	350.	350.	350.	9553	9652	9059	9593	3316	3091	3272	3238	3196	3303	2972	3189	781	789	797	785	0.916
84.2	350.	350.	350.	9553	9672	9059	9623	3316	3091	3277	3233	3191	3303	2972	3189	779	791	797	785	0.917
85.0	375.	375.	375.	10178	10297	9613	10208	3536	3300	3484	3453	3358	3519	3158	3390	829	841	853	835	0.916
86.0	350.	350.	350.	9563	9682	9009	9593	3326	3101	3277	3248	3202	3323	2977	3159	785	797	805	783	0.918
87.0	325.	325.	325.	8977	9067	9415	8989	3136	2912	3065	3043	3000	3129	2797	2993	737	749	755	735	0.920
88.0	300.	300.	300.	8411	8461	7801	8354	2927	2733	2848	2832	2803	2915	2667	2783	650	716	707	687	0.922
89.0	275.	275.	275.	7815	7745	7188	7710	2737	2544	2631	2627	2606	2713	2422	2577	642	680	659	639	0.923
90.0	250.	250.	250.	7229	7130	6594	7106	2527	2355	2414	2422	2404	2516	2227	2372	594	636	611	591	0.926
91.0	225.	225.	225.	6633	6504	6000	6501	2327	2166	2196	2202	2202	2304	2042	2171	548	588	563	543	0.933
91.1	200.	200.	200.	6017	5878	5405	5877	2127	1968	1982	1994	2000	2097	1851	1945	500	536	513	494	0.932
92.0	175.	175.	175.	5412	5243	4821	5262	1928	1786	1818	1796	1800	1891	1656	1745	451	485	466	446	0.938
92.1	150.	150.	150.	4796	4607	4207	4648	1718	1590	1566	1581	1595	1679	1481	1556	401	435	416	396	0.940
93.0	125.	125.	125.	4111	4061	3643	4023	1508	1391	1373	1376	1393	1467	1266	1369	349	383	368	348	0.947
94.0	75.	75.	75.	2822	2750	2514	2794	1088	994	964	960	979	1028	940	972	248	279	272	254	0.968
95.0	75.	75.	75.	2562	2651	2485	2705	1118	984	1016	995	979	1026	945	1043	331	317	310	316	0.964
95.1	125.	125.	125.	3813	3942	3623	3984	1538	1351	1415	1401	1383	1447	1316	1395	419	395	402	408	0.944
96.0	175.	175.	175.	5084	5193	4811	5213	1968	1729	1833	1811	1777	1865	1686	1830	508	504	488	498	0.920
96.1	225.	225.	225.	6345	6464	6000	6442	2377	2107	2252	2232	2176	2284	2062	2226	596	598	583	589	0.926
97.0	275.	275.	275.	7537	7696	7158	7621	2757	2485	2661	2642	2565	2677	2422	2607	688	688	679	675	0.917
97.1	325.	325.	325.	8838	8987	8396	8889	3166	2882	3086	3063	2984	3101	2797	3014	781	781	777	775	0.917
97.2	350.	350.	350.	9463	9622	9000	9524	3356	3071	3282	3273	3176	3296	2972	3204	825	827	823	821	0.916
98.0	375.	375.	375.	10109	10367	9603	10158	3536	3260	3480	3473	3368	3492	3158	3385	875	873	869	867	0.916
99.0	375.	325.	325.	9304	9533	8801	9365	3086	2862	2930	3023	2909	3061	2717	2958	777	781	789	765	0.911
100.0	375.	275.	275.	8480	8748	7990	8592	2647	2435	2580	2567	2459	2617	2362	2522	678	695	689	659	0.919
100.1	375.	275.	275.	8480	8788	7970	8572	2627	2445	2575	2562	2444	2607	2277	2512	668	684	685	651	0.920
101.0	375.	225.	225.	7676	7954	7178	7789	2187	2007	2116	2102	1954	2156	1861	2066	570	584	583	549	0.923
102.0	375.	175.	175.	6891	7116	6405	7006	1758	1580	1646	1636	1550	1695	1456	1624	465	479	478	446	0.928
102.1	375.	150.	150.	6484	6693	6009	6620	1558	1371	1424	1411	1358	1477	1306	1404	419	419	430	394	0.930
103.0	375.	125.	125.	6097	6276	5633	6243	1288	1143	1191	1181	1116	1250	1051	1178	355	363	376	342	0.934
103.1	375.	100.	100.	5700	5843	5237	5837	1058	934	959	950	904	1023	850	952	301	308	323	328	0.948
104.0	375.	75.	75.	5302	5431	4861	5441	839	715	737	725	686	861	695	732	248	248	268	310	0.945
105.0	325.	75.	75.	4905	5054	4485	5044	879	755	777	765	722	832	685	772	253	253	274	240	0.951
106.0	275.	75.	75.	4468	4657	4079	4648	909	805	818	805	767	858	730	822	255	257	278	262	0.957
107.0	225.	75.	75.	4041	4190	3712	4192	939	854	853	840	813	962	770	857	261	257	282	248	0.959
108.0	150.	75.	75.	3366	3515	3099	3508	999	924	914	910	878	958	835	927	269	263	290	252	0.962
109.0	75.	75.	75.	2740	2869	2534	2854	1048	984	969	970	929	998	890	987	275	269	298	260	0.969
114.0	75.	75.	75.	2671	2740	2613	2775	1008	954	964	965	934	973	940	977	289	287	314	280	0.960
115.0	125.	125.	125.	3326	3376	3217	3448	1198	1103	1116	1121	1056	1134	1001	1128	447	435	458	444	0.949
116.0	175.	175.	175.	3972	4031	3801	4093	1358	1232	1277	1261	1197	1286	1116	1263	519	500	523	511	0.937
117.0	225.	75.	225.	4647	4726	4415	4767	1548	1381	1424	1426	1393	1452	1261	1414	765	771	779	773	0.937
118.0	250.	75.	250.	4975	5054	4702	5064	1638	1451	1500	1501	1464	1527	1426	1479	845	855	863	857	0.933
119.0	275.	75.	275.	5312	5392	5039	5391	1718	1540	1585	1581	1545	1613	1501	1559	925	935	945	935	0.934
120.0	300.	75.	300.	5650	5727	5376	5728	1798	1610	1661	1661	1621	1695	1571	1634	995	1008	1020	1008	0.931
121.0	325.	75.	325.	5968	6037	5613	6035	1858	1685	1721	1721	1688	1766	1631	1695	1076	1088	1104	1088	0.927
122.0	350.	75.	350.	6305	6365	5920	6362	1938	1765	1803	1801	1762	1847	1701	1765	1152	1168	1184	1168	0.925
123.0	375.	75.	375.	6653	6693	6217	6689	2017	1838	1873	1876	1838	1921	1771	1835	1228	1248	1262	1246	0.924
123.1	400.	75.	400.	6991	7040	6544	7016	2107	1928	1969	1966	1919	2012	1851	1910	1309	1325	1342	1324	0.925
123.2	375.	75.	375.	6663	6722	6237	6699	2017	1848	1883	1886	1838	1926	1776	1840	1218	1251	1258	1236	0.924
123.3	375.	75.	375.	6772	6732	6267	6689	2007	1878	1858	1891	1853	1921	1771	1825	1158	1240	1244	1216	0.927
124.0	350.	75.	350.	6371	6411	5920	6362	1918	1790	1777	1801	1782	1835	1676	1745	1116	1152	1162	1132	0.924
125.0	325.	75.	325.	6047	6137	5623	6075	1848	1729	1722	1736	1676	1765	1604	1685	1028	1062	1056	1044	0.928
126.0	300.	75.	300.	5630	5829	5306	5738	1748	1650	1636	1641	1590	1679	1521	1609	947	973	993	961	0.927
127.0	275.	75.	275.	5382	5551	5019	5450	1688	1580	1576	1581	1520	1608	1456	1549	861	885	907	871	0.933
128.0	250.	75.	250.	5044	5223	4702	5123	1608	1500	1485	1491	1429	1522	1381	1464	775	795	819	785	0.932
129.0	225.	75.	225.	4697	4905	4386	4806	1508	1431	1414	1416	1358	1442	1306	1395	672	706	735	659	0.932
130.0	175.	75.	175.	4071	4280	3821	4182	1358	1302	1277	1276	1222	1302	1163	1253	518	526	563	525	0.944
131.0	125.	75.	125.	3414	3634	3227	3538	1188	1143	1116	1121	1066	1124	1026	1113	351	353	396	358	0.950
132.0	75.	75.	75.	2810	3028	2673	2913	1028	1003	965	980	929	973	890	972	184	174	226	188	0.972
133.0	75.	75.	75.	2671	2760	2574	2765	1048	1013	984	1001	959	998	960	1003	277	279	312	280	0.969
134.0	75.	125.	75.	3306	3396	3158	3399	1298	1252	1247	1261	1222	1265	1186	1258	208	204	244	212	0.962
135.0	75.	175.	75.	3902	4001	3712	3984	1558	1491	1494	1516	1469	1522	1411	1495	134	124	170	138	0.949
136.0	75.	225.	75.	4518	4627	4277	4598	1798	1739	1752	1776	1717	1780	1636	1750	64	50	98	68	0.943

STAGE	CNTR	RCTR	CRNR	C3	C2	B2	B3	A2	A3	C4	B4	C1	B1	D2	C3	D1	A4	A1	C4	RATIC
137.0	75.	250.	75.	4826	4925	4544	4905	1928	1858	1873	1896	1843	1906	1756	1870	28	14	62	32	0.939
137.1	200.	250.	200.	6395	6504	6019	6451	2317	2206	2267	2271	2212	2254	2092	2231	415	417	458	416	0.922
138.0	200.	275.	200.	6752	6891	6366	6798	2447	2345	2415	2427	2338	2440	2207	2373	393	395	433	394	0.929
139.0	200.	300.	200.	7040	7199	6663	7086	2567	2465	2554	2567	2474	2566	2327	2492	353	351	394	352	0.927
140.0	200.	325.	200.	7398	7487	6950	7383	2697	2595	2656	2682	2606	2687	2447	2602	315	311	356	314	0.924
141.0	200.	350.	200.	7745	7765	7237	7651	2807	2723	2772	2812	2732	2808	2557	2718	273	263	314	270	0.923
142.0	200.	375.	200.	8083	8063	7544	7968	3016	2872	2856	2957	2856	2955	2692	2843	230	174	208	228	0.924
142.1	200.	375.	200.	8123	8013	7524	7728	3006	2872	2873	2952	2878	2955	2687	2813	212	172	200	226	0.921
142.2	175.	375.	175.	7815	7706	7227	7421	2927	2803	2792	2877	2802	2879	2615	2748	134	88	120	148	0.924
142.3	150.	375.	150.	7497	7396	6930	7324	2847	2723	2712	2792	2722	2796	2547	2673	52	12	42	68	0.925
143.0	150.	350.	150.	7159	7100	6633	7016	2727	2604	2590	2672	2616	2677	2437	2552	86	36	74	102	0.927
144.0	150.	325.	150.	6911	6802	6346	6739	2807	2485	2464	2547	2484	2556	2322	2427	124	78	112	138	0.934
145.0	150.	300.	150.	6593	6484	6039	6432	2487	2355	2328	2412	2358	2425	2197	2296	160	116	150	176	0.930
146.0	150.	275.	150.	6295	6176	5752	6144	2357	2246	2202	2277	2227	2255	2087	2176	198	158	186	210	0.932
147.0	150.	250.	150.	5978	5858	5455	5827	2237	2117	2076	2142	2095	2156	1966	2046	232	194	222	244	0.931
147.1	75.	250.	75.	4995	4885	4524	4895	1958	1829	1823	1836	1863	1875	1731	1805	10	12	24	20	0.934
148.0	75.	225.	75.	4707	4577	4257	4608	1868	1729	1772	1721	1752	1776	1641	1705	30	46	40	46	0.944
149.0	75.	175.	75.	4061	3952	3673	3954	1608	1471	1459	1456	1489	1502	1401	1444	84	104	90	98	0.940
150.0	75.	125.	75.	3475	3346	3118	3369	1358	1232	1212	1206	1242	1266	1181	1198	160	182	166	172	0.952
151.0	75.	75.	75.	2889	2776	2603	2794	1118	1003	969	955	989	998	952	956	236	262	246	246	0.974
152.0	75.	75.	75.	2725	2790	2603	2924	1108	994	1000	960	974	993	980	987	238	269	256	254	0.972
152.1	125.	125.	125.	4021	3992	3742	4043	1518	1381	1392	1371	1383	1417	1301	1349	315	363	352	354	0.946
153.0	175.	175.	175.	5322	5253	4930	5292	1938	1779	1797	1786	1787	1835	1766	1730	467	469	444	452	0.937
153.1	225.	225.	225.	6573	6484	6108	6501	2347	2166	2257	2207	2191	2249	2147	2121	560	552	539	549	0.929
154.0	275.	275.	275.	7815	7765	7326	7740	2747	2564	2641	2637	2601	2667	2532	2512	596	656	637	647	0.926
154.1	300.	300.	300.	8321	8391	8009	8334	2917	2753	2843	2847	2781	2855	2717	2738	652	696	693	695	0.923
154.2	325.	325.	325.	9046	9036	8574	8959	3126	2942	3040	3058	2984	3065	2882	2928	766	744	743	743	0.921
154.3	350.	350.	350.	9642	9642	9158	9573	3316	3151	3242	3268	3191	3267	3038	3159	775	795	799	797	0.920
155.0	375.	375.	375.	10297	10258	9732	10168	3536	3349	3444	3478	3398	3474	3208	3365	843	849	857	849	0.919
156.0	400.	400.	400.	10844	10923	10306	10733	3706	3558	3656	3693	3590	3686	3342	3580	909	909	919	909	0.916
156.1	400.	400.	400.	10714	10934	10277	10773	3706	3558	3681	3688	3586	3686	3336	3582	925	915	933	915	0.915
157.0	425.	425.	425.	11360	11505	10861	11308	3936	3777	3888	3898	3813	3898	3553	3816	963	973	997	967	0.915
158.0	450.	450.	450.	12005	12025	11425	11982	4135	4015	4111	4134	3979	4210	3733	4067	969	957	979	931	0.909
155.0	425.	425.	425.	11370	11410	10811	11357	3936	3827	3904	3922	3772	4004	3636	3876	933	909	939	891	0.915
160.0	400.	400.	400.	10754	10824	10217	10733	3726	3638	3707	3723	3570	3797	3453	3688	889	859	893	845	0.917
161.0	375.	375.	375.	10129	10208	9613	10109	3536	3445	3506	3523	3368	3595	3255	3486	843	809	845	797	0.918
161.1	375.	375.	375.	10148	10218	9633	10089	3526	3439	3489	3523	3363	3585	3273	3480	843	847	847	795	0.918
161.2	375.	375.	375.	10176	10268	9623	10059	3536	3449	3506	3528	3378	3586	3275	3486	837	811	843	795	0.917
161.3	375.	375.	375.	10218	10258	9663	10049	3516	3429	3464	3523	3373	3566	3263	3446	835	805	839	791	0.917
161.4	375.	375.	375.	10168	10188	9831	10099	3476	3419	3474	3528	3363	3624	3233	3505	821	785	821	751	0.917
161.5	375.	375.	375.	10158	10178	9851	10099	3466	3419	3475	3523	3368	3624	3238	3516	817	779	817	745	0.917
162.0	350.	350.	350.	9553	9563	9257	9494	3266	3230	3277	3328	3166	3318	2967	3124	765	728	769	695	0.919
163.0	325.	325.	325.	8937	8947	8653	8889	3076	3031	3075	3118	2956	3114	2767	2932	720	678	721	647	0.921
164.0	275.	275.	275.	7676	7706	7435	7670	2677	2644	2661	2707	2565	2705	2452	2732	626	580	627	549	0.925
165.0	225.	225.	225.	6434	6454	6237	6480	2277	2256	2242	2282	2161	2284	2107	2226	530	481	533	454	0.910
166.0	175.	175.	175.	5193	5213	5059	5232	1858	1868	1828	1861	1752	1866	1726	1525	433	385	436	360	0.937
167.0	125.	125.	125.	3942	3952	3871	3984	1438	1471	1409	1446	1348	1442	1351	1439	339	291	344	270	0.948
168.0	75.	75.	75.	2691	2701	2712	2725	1008	1063	984	1021	939	1018	976	1098	244	194	252	182	0.964
169.0	125.	125.	125.	3972	3962	3732	3996	1448	1461	1398	1441	1343	1442	1331	1459	337	291	344	270	0.943
170.0	175.	175.	175.	5223	5253	4990	5262	1868	1858	1813	1846	1742	1870	1766	1900	433	395	438	364	0.936
171.0	225.	225.	225.	6484	6514	6158	6491	2277	2246	2227	2262	2146	2285	2077	2296	528	483	533	458	0.929
171.1	225.	225.	225.	6454	6544	6059	6541	2297	2246	2232	2242	2146	2314	2077	2276	522	477	533	464	0.928
172.0	250.	225.	225.	6643	6722	6237	6367	2277	2176	2207	2167	2121	2314	2056	2291	512	473	513	454	0.928
173.0	275.	225.	225.	6832	6981	6455	7244	2226	2127	2186	2102	2096	2294	2027	2276	516	469	498	450	0.928
174.0	300.	225.	225.	7070	7269	6673	7512	2267	2087	2156	2102	2065	2264	2007	2256	512	471	492	446	0.929
175.0	325.	225.	225.	7259	7428	6861	7750	2237	2047	2141	2072	2050	2244	1971	2241	506	473	490	440	0.927
176.0	350.	225.	225.	7457	7636	6960	8007	2207	1998	2116	2037	2025	2228	1956	2221	504	475	496	438	0.925
177.0	375.	225.	225.	7706	7874	7267	8334	2187	1978	2085	2012	2005	2203	1926	2186	504	473	498	436	0.929
178.0	350.	225.	225.	7527	7646	7099	7720	2197	2057	2116	2087	2020	2221	1946	2196	506	467	498	436	0.924
179.0	325.	225.	225.	7348	7469	6910	7571	2217	2097	2141	2117	2040	2228	1966	2211	504	463	498	436	0.927
180.0	300.	225.	225.	7110	7259	6712	7324	2247	2147	2171	2162	2065	2254	1981	2246	504	463	501	436	0.929
181.0	275.	225.	225.	6901	7060	6495	7086	2267	2157	2186	2177	2080	2264	1996	2256	502	461	498	434	0.928
182.0	250.	225.	225.	6663	6832	6277	6828	2287	2196	2207	2207	2111	2254	2022	2286	502	459	498	434	0.927
183.0	225.	225.	225.	6454	6633	6089	6610	2307	2226	2237	2232	2136	2314	2042	2311	502	459	498	434	0.929
183.1	225.	225.	225.	6474	6683	6089	6560	2307	2246	2237	2252	2156	2304	2027	2306	494	446	498	430	0.929
184.0	250.	250.	250.	7090	7269	6693	7155	2567	2445	2424	2442	2258	2521	2217	2507	544	497	545	478	0.926
185.0	275.	275.	275.	7715	7924	7297	7760	2717	2644	2651	2677	2540	2723	2417	2703	592	546	595	527	0.925

STAGE	CNTR	RCTR	CRNR	C3	C2	B2	B3	A2	A3	C4	B4	C1	B1	D2	C3	D1	A4	A1	C4	RATIC
186.0	300.	300.	300.	8361	8540	7900	8384	2917	2852	2858	2887	2742	2934	2607	2903	642	596	643	575	0.924
187.0	325.	325.	325.	8967	9126	8504	8989	3116	3031	3065	3093	2944	3141	2797	3095	652	646	693	625	0.921
188.0	350.	350.	350.	9592	9751	9099	9583	3316	3240	3277	3328	3146	3362	2992	3296	746	698	743	675	0.919
189.0	375.	375.	375.	10198	10436	9693	10198	3526	3449	3494	3518	3348	3567	3187	3505	757	751	793	717	0.919
189.1	375.	375.	375.	10287	10407	9762	10218	3496	3419	3455	3493	3328	3559	3208	3430	779	757	793	745	0.919
189.2	375.	375.	375.	10119	10158	9643	10059	3516	3419	3484	3538	3358	3586	3268	3470	869	823	863	819	0.917
189.3	375.	375.	375.	10099	10158	9643	10029	3536	3419	3489	3553	3368	3575	3268	3470	857	821	851	821	0.917
189.4	375.	375.	375.	10039	10168	9663	10039	3526	3409	3489	3548	3358	3570	3263	3465	853	821	853	813	0.916
189.5	375.	375.	375.	10129	10178	9702	10079	3506	3389	3484	3533	3353	3555	3243	3465	831	799	831	793	0.916
189.6	375.	375.	375.	10178	10228	9742	10138	3506	3389	3474	3523	3358	3556	3248	3445	801	771	803	763	0.916
189.7	375.	375.	375.	10178	10258	9752	10138	3496	3389	3474	3518	3353	3555	3243	3445	799	769	801	759	0.916
189.8	375.	375.	375.	10178	10268	9752	10138	3496	3389	3474	3518	3353	3545	3238	3445	797	769	799	759	0.916
190.0	400.	400.	400.	10784	10913	10366	10743	3686	3598	3681	3723	3555	3751	3423	3665	851	819	855	807	0.916
191.0	425.	425.	425.	11390	11505	10950	11347	3886	3787	3888	3928	3757	3955	3578	3872	967	873	907	1036	0.918
192.0	450.	450.	450.	11996	12095	11524	11942	4105	3986	4095	4144	3959	4165	3733	4082	953	921	953	859	0.912
193.0	475.	475.	475.	12601	12691	12089	12556	4315	4184	4297	4359	4176	4377	3893	4282	1002	967	1002	947	0.912
194.0	500.	500.	500.	13177	13257	12623	13141	4525	4403	4525	4574	4393	4604	4195	4493	1050	1016	1056	1002	0.910
195.0	300.	300.	300.	8222	8282	7772	8344	2917	2852	2868	2907	2792	2990	2712	2903	664	614	673	617	0.920
196.0	400.	400.	400.	10734	10804	10207	10792	3726	3628	3702	3738	3601	3812	3466	3701	853	811	869	813	0.916
197.0	450.	450.	450.	11360	12015	11376	12021	4125	4005	4104	4138	3969	4192	3787	4097	947	911	969	905	0.912
198.0	500.	500.	500.	13167	13197	12544	13151	4495	4413	4525	4574	4404	4604	4225	3581	1048	1012	1066	1004	0.904
199.0	525.	525.	525.	13743	13813	13136	13696	4735	4622	4737	4799	4626	4815	4415	4694	1068	1060	1114	1056	0.910
199.1	525.	525.	525.	13733	13793	13356	13637	4725	4622	4742	4804	4671	4659	4424	4694	1068	1058	1116	1060	0.909
200.0	550.	550.	550.	14329	14409	13940	14231	4935	4840	4976	5045	4883	4936	4614	4919	1122	1098	1168	1098	0.909
200.1	550.	550.	550.	14289	14409	13821	14331	4995	4751	5035	4799	4898	4967	4615	4515	1114	1321	1140	1126	0.909
200.2	550.	550.	550.	14259	14449	13910	14273	5014	4831	4979	4811	4929	4956	4615	4515	1114	1299	1142	1122	0.909
200.2	550.	550.	550.	14369	14548	13742	14222	5014	4811	4964	4799	4908	4841	4584	4764	1230	1297	1282	1264	0.909
201.0	400.	400.	400.	10675	10824	10128	10564	3816	3658	3742	3583	3601	3671	3468	3605	943	987	977	961	0.916
202.0	200.	200.	200.	5710	5858	5326	5708	2187	2087	2090	1951	1884	2062	1951	2021	550	570	571	557	0.931
202.1	200.	200.	200.	5729	5858	5297	5619	2187	2087	2075	1966	1975	2042	1941	1595	576	600	605	587	0.931
203.0	300.	300.	300.	8282	8262	7673	8047	3006	2882	2962	2792	2882	2955	2681	2773	570	801	797	783	0.918
204.0	400.	400.	400.	10864	10854	10069	10455	3826	3655	3686	3608	3580	3661	3413	3576	967	1006	997	989	0.912
205.0	500.	500.	500.	13177	13326	12435	12993	4635	4413	4530	4414	4383	4467	4184	4343	1162	1216	1200	1154	0.910
206.0	525.	525.	525.	13773	13972	13039	13528	4825	4612	4742	4609	4580	4664	4374	4543	1210	1267	1250	1244	0.909
207.0	550.	550.	550.	14359	14587	13643	14132	5034	4831	4954	4824	4782	4856	4564	4745	1261	1317	1300	1452	0.911
208.0	575.	575.	575.	14955	15104	14316	14727	5174	4950	5126	5090	4964	5027	4815	4939	1283	1339	1348	1533	0.908
209.0	375.	375.	375.	10005	10139	9574	9990	3616	3389	3478	3493	3434	3545	3245	3425	903	937	965	931	0.918
209.1	375.	375.	375.	10000	10049	9633	9360	3596	3389	3484	3493	3424	3415	3278	3436	915	935	965	917	0.917
210.0	500.	500.	500.	13088	13128	12653	13042	4595	4343	4489	3958	3419	4412	4814	4358	1132	987	1216	1194	0.899
211.0	550.	550.	550.	14319	14369	13851	14261	4995	4721	4893	4859	4828	4805	4684	4789	1228	1293	1318	1284	0.909
212.0	575.	575.	575.	14895	14975	14455	14365	5144	4900	5090	5135	5025	5022	4875	5000	1277	1319	1406	1330	0.909
213.0	600.	600.	600.	15491	15402	15039	15480	5244	5278	5282	5390	5252	5265	5105	5245	1339	1303	1456	1360	0.907
213.1	600.	600.	600.	15470	15431	15029	15569	5254	5198	5265	5399	5252	5255	5095	5225	1339	1343	1454	1358	0.908
214.0	625.	625.	625.	16226	16236	15653	16015	5524	5437	5484	5585	5454	5360	5125	5525	1429	1377	1496	1458	0.907
215.0	650.	650.	650.	16941	16762	16158	16580	5704	5586	5626	5735	5686	5622	5311	5536	1481	1500	1577	1531	0.906
216.0	675.	675.	675.	17418	17368	17158	16767	5844	5785	5883	5970	5818	5652	5488	5837	1510	1574	1695	1507	0.905
217.0	700.	700.	700.	17864	18053	17702	17859	6053	5834	6085	6031	5944	5748	5628	6028	1566	1702	1767	1577	0.904
218.0	725.	725.	725.	18560	18778	18752	18275	6033	6003	6316	6161	6564	5785	5946	6118	1666	1815	1894	1625	0.902
219.0	750.	750.	750.	19245	19505	19405	18959	6113	6182	6393	6222	6131	5826	6151	6213	1766	1928	2014	1701	0.899
220.0	775.	775.	775.	20039	20278	19970	19583	6223	6441	6576	6231	6262	5829	6361	6273	1793	1915	2112	1771	0.896
221.0	400.	400.	400.	10675	10248	10841	10485	3346	3558	3636	3348	3297	3620	3336	3435	1101	1146	1318	1080	0.900
222.0	600.	600.	600.	15680	16156	15742	15361	4995	5133	5232	4934	4863	4558	5323	4984	1463	1540	1709	1448	0.893
223.0	750.	750.	750.	19642	20000	19534	19177	6193	6302	6455	6141	6121	5763	5566	6173	1751	1863	2022	1731	0.908
224.0	775.	775.	775.	20256	20277	19781	19611	6333	6481	6636	6327	6241	5967	6177	6254	1822	1918	2124	1785	0.906
225.0	800.	800.	800.	21042	21459	21029	20455	6513	6540	6681	6271	6348	5976	6359	6459	1859	2026	2264	1781	0.904
226.0	825.	825.	825.	21618	22085	21702	21377	6593	6679	6975	6366	6424	6152	6386	6649	1905	2076	2112	1837	0.902
227.0	850.	850.	850.	22065	22363	21732	21565	6743	6819	7222	6371	6565	6268	6461	6674	1712	1963	1943	1627	0.884
228.0	557.	557.	557.	15223	15638	15524	15232	4235	4362	4626	3908	4630	3858	4204	4257	1180	1401	1410	1166	0.899
229.0	543.	543.	543.	15034	15660	15366	14985	4145	4304	4540	3838	3569	3812	4134	4182	1158	1371	1390	1142	0.906
230.0	600.	600.	600.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
231.0	659.	659.	659.	17884	18391	18069	17740	5094	5248	5474	4769	4559	4725	5021	5075	1257	1495	1509	1268	0.899
232.0	710.	710.	710.	19155	19523	19257	18939	5564	5705	5898	5240	5449	5153	5465	5496	1333	1598	1601	1370	0.899
233.0	600.	825.	825.	20506	20269	20287	19950	6613	6769	6949	6351	6595	6278	6501	6634	1584	1865	1859	1639	0.902
234.0	600.	850.	850.	20764	20583	20831	20445	6743	6858	7065	6471	6732	6394	6641	6785	1646	1951	1939	1681	0.901
235.0	600.	875.	875.	21479	21578	21366	21030	6833	6978	7181	6601	6858	6525	6651	6915	1710	1985	2000	1687	0.899
236.0	600.	900.	900.	22035	22105	22009	21744	7002	7097	7237	6701	6929	6626	6721	7061	1738	1985	1975	1699	0.896
237.0	600.	925.	925.	22671	22562	22623	22190	7132	7207	7207	6841	7035	6666	6761	7156	1869	2058	2018	1825	0.894

D.3 STRAINS

The following listing contains the readings in micro-strain units, of all 140 channels of the data logger for all Load Stages during the test. The first column contains the Load Stage numbers and the second column contains numbers which define the load, e.g., at LS32 the number, 220722, is an abbreviation for columns 2, 3 and 4 of the previous tables in Sections D.1 and D.2, and represents a load of 225 psf on the centre panel, 75 psf on the rectangular or centre-edge panels, and 225 psf on the corner panels.

The number at the head of each subsequent column refers to data logger channel to which the gauge was wired. Figures 7.2 and 7.3 show the location of the gauges on the slab. A Philips PR 9249A dummy strain gauge cell was wired to each of channels 1, 21, 41, 61, 81, 101 and 121 to check the performance of the logger. Gauges mounted on the steel in two specially made reinforced blocks were wired to channels 139 and 140 to check the effect of temperature on the steel strain readings.

All readings have LS1 as datum but no other reduction has been made to any reading.

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 1	CHAN 2	CHAN 3	CHAN 4	CHAN 5	CHAN 6	CHAN 7	CHAN 8	CHAN 9	CHAN 10	CHAN 11	CHAN 12	CHAN 13	CHAN 14	CHAN 15	CHAN 16	CHAN 17	CHAN 18	CHAN 19	CHAN 20
1 70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A 70707	-2	-1	0	-1	-1	3	-2	1	-1	0	1	-2	1	-4	0	0	5	0	-1	0
2 101010	-1	3	-2	-1	0	5	0	-1	2	3	-3	-2	3	-8	0	4	1	-2	-2	-4
2A 101010	0	2	-4	-3	-3	2	0	-2	-1	0	-4	-5	2	-12	0	4	2	-2	-2	-5
3 121212	-2	3	0	-2	2	9	-5	-1	2	3	-6	-10	3	-12	0	3	0	-5	-4	-6
3A 121212	2	7	5	1	6	9	-5	-2	1	1	-8	-5	3	-12	0	3	2	-7	-4	-6
4 151515	2	13	7	10	8	16	-3	0	4	5	-12	-5	3	-8	0	4	5	-8	-2	-2
4A 151515	2	13	12	9	10	20	-1	0	9	5	-11	-5	8	-8	0	8	4	-7	-5	0
5 171717	0	16	11	11	13	24	-4	-2	5	2	-15	-7	9	-6	0	7	3	-12	-8	-3
5A 171717	0	17	13	12	12	26	-5	-2	4	4	-18	-6	3	-4	0	5	1	-15	-8	-1
6 202020	1	27	28	26	25	43	2	0	9	6	-24	-4	7	0	0	9	4	-17	-9	5
6A 202020	0	26	27	24	25	46	0	0	9	4	-28	-7	5	0	0	7	2	-18	-8	6
7 222222	2	30	32	30	30	47	0	0	8	7	-26	-6	10	1	0	7	8	4	-20	0
7A 222222	3	30	28	27	28	45	1	-2	9	9	-28	-5	8	-1	0	7	3	-18	-10	5
7B 222222	1	30	29	26	29	47	-3	-4	10	7	-28	-3	11	0	0	10	5	-18	-10	4
8 202020	2	25	27	22	23	40	-5	-1	8	3	-25	-3	7	-3	0	9	0	-15	-8	7
8A 202020	2	27	27	24	23	40	-2	0	6	3	-25	-3	6	0	0	10	2	-18	-10	6
9 151515	2	22	22	17	15	30	-1	-2	3	0	-16	-2	3	0	0	8	0	-11	-5	8
9A 151515	2	20	19	17	15	28	0	0	2	0	-17	-2	6	0	0	5	-2	-10	-7	6
10 70707	1	10	13	10	4	17	3	4	0	-1	-1	5	3	7	0	4	-2	-1	0	10
10A 70707	1	8	11	5	5	15	0	3	2	-2	-5	1	1	4	0	2	-2	-2	-2	10
13 70707	12	40	61	56	51	58	32	35	19	17	8	28	11	44	0	25	9	15	12	55
13 70707	13	38	56	53	49	50	30	34	20	17	9	30	9	50	0	27	10	15	13	51
14 101010	13	42	57	54	50	57	28	29	19	17	5	27	14	40	0	27	10	14	13	48
14 101010	13	41	55	52	51	54	28	31	22	19	5	27	15	38	0	27	10	14	13	47
15 121212	13	41	53	53	49	56	27	28	23	17	4	23	17	35	0	29	12	10	13	44
15 121212	13	41	53	53	53	58	25	30	23	20	5	23	16	34	0	30	13	12	13	41
16 151515	13	43	53	53	53	60	24	28	24	20	5	21	13	31	0	30	13	5	13	38
16 151515	15	47	57	53	53	59	28	28	23	20	3	21	18	31	0	30	15	7	12	39
17 171717	15	50	57	53	56	64	24	24	28	20	0	21	19	28	0	30	16	5	12	36
17 171717	16	50	55	57	55	65	24	24	26	26	0	21	22	30	0	32	15	5	14	36
18 202020	13	50	53	56	59	67	21	21	29	23	-7	16	22	28	0	34	17	2	12	34
18 202020	13	52	57	58	59	65	22	21	29	24	-5	18	22	34	0	34	17	4	12	33
19 222222	12	54	59	58	62	69	20	22	29	22	-13	15	21	23	0	32	16	1	13	29
19 222222	15	53	57	58	60	69	20	24	29	20	-10	18	23	23	0	34	18	0	12	31
20 202020	15	52	54	53	53	55	65	21	23	30	21	-6	18	23	25	0	34	18	4	13	34
20 202020	13	50	53	53	53	53	60	20	24	29	24	-6	18	20	26	0	34	16	4	10	30
21 171717	13	47	49	50	54	60	20	25	24	20	0	21	22	25	0	30	13	5	10	30
21 171717	13	48	49	53	52	60	23	26	27	20	-3	19	22	26	0	33	17	4	13	34
22 121212	13	38	41	43	42	48	24	30	24	17	7	18	19	27	0	30	16	11	14	34
22 121212	13	39	39	42	40	48	24	26	24	18	6	21	18	23	0	30	17	12	14	32
23 70707	18	30	30	33	33	36	22	29	24	20	19	23	19	26	0	29	15	24	20	29
23 70707	19	31	31	31	30	35	22	29	23	20	17	23	17	25	0	30	16	22	20	30
26 70707	17	31	28	30	29	30	22	26	24	20	14	21	19	20	0	28	18	24	22	25
26 70707	17	27	23	28	29	29	21	26	24	19	15	18	18	18	0	28	18	22	22	21
27 100710	18	26	22	23	22	32	19	26	27	23	14	19	20	16	0	28	17	20	21	20
27 100710	13	23	20	24	23	30	18	24	24	20	12	18	18	13	0	27	16	18	22	21
28 120712	19	23	18	24	23	35	15	26	24	20	8	17	17	16	0	27	17	14	20	18
28 120712	20	26	19	22	22	37	18	24	24	20	9	17	20	14	0	28	17	14	22	20
29 130715	18	23	16	23	21	47	18	21	24	20	5	18	18	13	0	26	18	12	22	19
29 130715	19	22	15	22	21	40	17	23	24	20	5	17	20	11	0	26	18	13	20	20
30 170717	19	21	13	20	19	44	18	21	24	17	2	15	18	11	0	26	15	5	17	15
30 170717	20	22	15	20	20	45	15	20	24	19	1	18	19	14	0	25	17	5	18	41
31 200720	20	23	17	22	21	53	15	24	24	18	-2	18	18	11	0	27	17	5	20	21
31 200720	19	22	13	20	19	50	15	23	24	19	-2	18	21	11	0	27	18	5	20	16
32 220722	21	22	13	17	15	57	17	21	28	20	-7	18	21	14	0	26	18	2	20	16
32 220722	20	21	13	18	15	56	15	24	24	20	-6	16	21	12	0	27	19	0	20	16
33 200720	21	23	13	19	15	50	15	23	29	20	-5	16	23	10	0	28	19	4	21	18
33 200720	19	22	10	19	15	50	14	21	28	21	-4	17	21	11	0	27	18	5	19	16
34 170717	22	21	12	17	15	45	13	23	27	20	0	15	21	11	0	25	19	7	22	16
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35 150715	19	19	13	13	17	40	14	19	29	20	4	17	20	10	0	24	18	14	20	11
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37 100710	18	23	13	19	18	30	13	18	28	24	12	15	23	10	0	27	20	17	22	13
37 100710	20	23	16	20	21	31	13	20	31	25	11	17	23	10	0	28	24	18	22	16
38 70707	24	32	33	33	35	43	25	25	34	30	23	23	25	24	0	30	26	22	23	28
38 70707	20	29	31	32	34	40	25	24	34	30	19	23	23	21	0	27	27	20	21	27
51 70707	13	-444	42	45	44	54	25	31	31	22	12	18	13	33	0	18	19	10	12	41
51 70707	13	32	42	46	43	49	23	23	31	24	12	18	13	29	0	20	19	10	11	40
52 71007	13	37	43	46	44	47	21	21	33	27	14	19	18	29	0	26	25	14	13	38
52 71007	14	35	42	43	40	47	20	19	32	28	14	15	18	26	0	24	22	14	11	36
53 71207	18	36	43	48	45	40	20	20	34	28	14	14	20	25	0	25	25	17	13	32
53 71207	16	33	39	43	43	39	18	16	36	28	14	12	20	21	0	24	24	16	13	29
54 71507	17	40	40	46	45	33	14	16	39	30	14	12	22	16	0	27	29	16	15	26
54 71507	17	36	40	42	45	35	13	11	34	27	13	8	22	15	0	27	26	20	13	26
55 71707	19	39	39	43	44	27	9	8	38	30	13	6	23	10	0	28	29	20	13	17
55 71707	18	40	38	41	43	26	8	8	37	28	14	6	23	10	0	29	30	22	13	14
56 72007	18	43	40	43	45	27	5	6	40	33	14	3	26	4	0	30	32	24	13	11
56 72007	19	43	42	43	46	25	5	6	43	34	18	4	28	2	0	30	33	22	13	11
57 72207	17	48	43	46	49	25	5	4	44	37	14	0	30	0	0	34	34	24	14	9
57 72207	18	47	42	45	49	24	5	3	44	36	13	1	29	0	0	33	32	23	17	11
58 72007	21	40	39	40	43	26	5	5	43	35	16	1	27	-1	0	30	30	24	18	9
58 72007	19	40	38	40	44	24	5	5	41	37	17	1	28	0	0	33	34	24	15	11
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59 71707	18	38	34	33	38	20	5	4	40	33	18	0	27	1	0	30	32	22	18	10
60 71507	17	32	30	31	32	20	7	5	41	30	20	3	23	0	0	30	30	22	18	10
60 71507	19	33	28	32	33	22	5	6	40	33	17	3	26	0	0	28	30	22	20	9
61 71207	18	27	23	24	30	9	5	-1	36	30	28	5	23	1	0	29	30	21	10	
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63 70707	19	19	17	18	20	24	12	10	37	28	21	9	23	6	0	24	29	21	20	11
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1A 70707	3	15	11	11	14	18	8	4	37	30	19	7	23	0	0	23	30	20	23	8
2A 101010	17	18	13	13	15	20	4	4	38	30	17	3	25	-6	0	26	30	17	22	1
3A 121212	20	23	13	16	18	23	3	2	42	33	11	-1	28	-6	0	27	32	15	20	-1
4A 151515	20	23	13	16	18	24	2	0	43	33	8	-3	27	-12	0	28	34	11	16	-2
5A 171717	18	30	17	20	24	30	1	-2	44	35	4	-5	31	-14	0	30	35	10	19	-4
6A 202023	19	31	21	24	29	37	-3	-3	50	35	4	-5	32	-13	0	30	36	4	20	-6
7A 222222	18	36	22	25	32	40	-6	-6	49	36	-4	-9	33	-16	0	30	37	2	19	-9
8A 202020	20	33	20	23	28	39	-2	-6	50	33	1	-2	33	-14	0	30	38	5	20	-6
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10A 151515	16	23	13	15	20	28	-1	-2	44	33	8	-2	30	-12	0	28	35	13	18	-7
11A 121212	18	20	10	9	14	23	-1	0	45	34	14	3	32	-12	0	28	33	15	22	-7
12A 101010	19	15	11	11	15	23	2	0	42	34	18	3	32	-6	0	24	34	17	24	6
13A 70707	19	13	11	13	15	25	5	4	41	30	22	7	28	1	0	22	30	17	23	5
76 70707	13	22	36	35	34	42	16	18	48	34	22	18	26	20	0	28	28	22	22	29
77 121213	17	33	40	38	38	49	13	14	51	36	14	12	30	14	0	30	33	18	22	26
77A 151515	19	35	42	42	41	49	14	11	54	36	14	12	31	11	0	35	35	15	23	20
78 171717	17	36	37	38	35	47	8	10	57	38	11	9	35	8	0	38	37	12	22	16
78A 202020	16	39	41	39	36	50	5	4	58	38	7	5	33	6	0	39	35	10	20	14
79 222222	17	42	46	43	43	56	3	1	60	39	2	3	35	0	0	40	37	5	20	15
80 252525	15	43	43	41	45	60	3	-2	62	38	-5	1	38	-1	0	40	37	5	20	14
80A 252525	18	43	46	43	45	60	1	0	61	40	-1	5	41	-3	0	40	37	8	20	12
81 272727	13	51	42	39	43	59	-7	-9	59	37	-10	-7	34	-9	0	40	37	-1	17	1
81A 272727	15	51	41	41	45	60	-5	-6	60	40	-9	-7	36	-9	0	39	39	0	17	1
82 303030	15	53	43	42	50	67	-8	-6	61	40	-16	-8	41	-9	0	45	40	-3	12	-2
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83 323232	16	53	43	45	47	77	-8	-9	60	38	-24	-14	41	-14	0	45	39	-8	12	-2
83A 323232	19	55	46	47	50	85	-8	-9	61	40	-26	-11	41	-15	0	46	39	-8	10	-2
84 353535	22	59	52	53	55	130	-5	-6	64	45	-32	-13	43	-14	0	47	39	-8	10	-2
84A 353535	19	59	50	50	55	133	-8	-9	64	44	-35	-13	42	-16	0	47	40	-8	10	-1

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84C 353535	19	58	51	48	54	147	-10	-10	71	45	-35	-13	42	-14	C	46	40	-9	12	-4
85 373737	19	63	53	58	60	164	-9	-12	63	44	-40	-15	40	-12	C	44	40	-15	10	-3
85A 373737	19	66	56	56	60	170	-8	-12	64	45	-40	-16	41	-16	C	40	42	-15	8	-5
86 353535	21	59	51	52	55	170	-10	-11	60	40	-35	-15	34	-15	C	43	38	-13	8	-3
87 323232	20	54	43	48	50	168	-11	-10	59	40	-33	-13	36	-16	C	39	38	-10	10	-3
88 303030	21	52	41	43	45	162	-8	-9	58	40	-26	-13	36	-13	C	39	38	-7	12	-1
89 272727	21	50	42	42	45	159	-6	-9	59	42	-21	-9	38	-10	C	38	37	-5	13	-2
90 252525	13	-443	38	36	42	150	-6	-7	57	40	-19	-11	37	-11	C	37	33	1	13	-1
91 222222	19	40	30	32	34	144	-6	-6	54	39	-15	-9	33	-10	C	37	35	4	15	-1
91A 202020	20	38	29	29	33	137	-1	-4	57	40	-7	-7	37	-10	C	38	36	8	18	0
92 171717	21	33	28	26	28	132	-3	-2	56	40	1	-6	36	-9	C	39	36	12	18	1
93A 151515	20	28	21	21	22	125	-1	0	54	36	4	-3	32	-5	C	37	35	14	23	3
93 121212	21	21	18	18	17	117	0	-2	54	36	9	-5	31	-5	C	36	35	18	23	3
94 70707	20	12	11	9	9	100	2	2	51	35	19	0	30	-4	C	34	35	25	26	6
95 70707	13	76	35	42	34	277	15	13	53	35	8	11	31	20	C	30	29	19	15	29
95A 121212	16	33	46	46	40	137	12	8	58	39	10	8	29	14	C	35	30	18	15	29
96 171717	19	40	50	53	48	145	5	5	62	44	2	6	33	11	C	38	34	8	16	23
96A 222222	16	43	53	53	51	160	3	-1	61	43	-7	-4	32	4	C	39	38	5	13	18
97 272727	15	53	59	62	57	173	1	-3	64	45	-18	-8	34	0	C	40	41	0	13	13
97A 323232	17	60	67	66	64	190	-4	-8	64	46	-23	-6	40	-4	C	40	38	-8	9	9
97B 353535	18	63	64	69	73	204	-6	-9	70	46	-31	-7	42	-4	C	45	40	-12	10	8
98 373737	17	65	66	72	64	286	-10	-19	71	50	-36	-18	40	-10	C	46	43	-16	7	1
99 373232	17	55	56	66	53	493	-22	-32	62	53	-29	-32	32	-24	C	42	44	-18	8	-6
100 372727	18	46	45	43	43	330	-22	-35	56	53	-27	-31	31	-26	C	40	47	-19	11	-9
100A 372727	19	43	44	43	40	538	-21	-36	54	53	-27	-35	31	-26	C	40	47	-16	12	-11
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101 372222	17	30	31	32	28	580	-25	-39	53	55	-23	-36	30	-31	C	38	48	-18	15	-16
101A 372222	18	31	30	31	28	583	-24	-39	55	57	-25	-37	31	-30	C	39	47	-16	16	-14
102 371717	17	21	19	18	15	595	-22	-40	53	53	-25	-35	26	-32	C	35	45	-18	16	-10
102A 371717	13	18	16	14	13	590	-25	-41	51	50	-26	-37	25	-34	C	33	45	-18	14	-14
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103B 371010	18	3	3	0	-5	620	-18	-39	50	49	-22	-32	26	-32	C	32	44	-20	20	-12
103C 371010	17	2	3	2	-5	615	-20	-38	49	50	-18	-31	28	-30	C	30	40	-18	20	-14
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104A 370707	21	-4	-8	-7	-10	623	-18	-39	47	47	-20	-31	25	-35	C	30	40	-22	18	-15
105 370707	19	0	1	-3	-7	603	-20	-36	49	50	-12	-30	28	-32	C	30	41	-12	21	-12
106 370707	18	-2	0	-4	-6	566	-22	-36	49	50	-2	-31	27	-34	C	30	42	-5	23	-14
107 370707	20	1	3	0	-3	535	-18	-32	53	53	7	-27	29	-30	C	34	45	5	27	-14
108 150707	21	3	4	3	0	473	-17	-34	56	56	24	-27	31	-29	C	37	44	18	32	-11
109 70707	19	8	11	7	3	410	-17	-31	58	55	36	-25	31	-29	C	39	48	31	36	-11
114A 70707	11	26	52	50	40	437	3	-3	79	64	52	-3	30	10	C	54	40	42	44	30
115 120712	13	23	52	46	39	467	3	-5	78	67	42	-5	30	8	C	56	43	37	45	29
116 170717	13	21	44	41	32	502	-2	-9	79	62	34	-5	30	3	C	54	40	25	43	24
117 220722	12	17	40	38	28	538	-2	-9	76	64	27	-8	31	0	C	50	40	19	41	19
118 250725	13	17	37	33	27	557	-2	-12	78	63	24	-7	31	-6	C	50	40	18	42	19
119 270727	13	13	33	30	21	577	-6	-13	74	62	21	-12	30	-8	C	53	43	10	40	16
120 300730	12	9	30	23	15	594	-5	-16	74	60	14	-16	28	-11	C	50	42	7	42	13
121 320732	14	8	28	25	15	614	-7	-16	71	60	11	-9	28	-10	C	50	42	2	41	11
122 350735	13	8	24	22	14	633	-5	-19	74	63	7	-12	30	-12	C	50	44	-2	41	11
123 370737	14	5	21	18	11	665	-7	-19	74	63	17	-14	30	-16	C	50	42	-5	41	10
123A 400740	13	2	17	15	5	686	-15	-26	71	63	0	-18	28	-20	C	47	42	-10	42	1
123B 370737	12	0	13	10	3	680	-15	-28	67	63	5	-22	23	-22	C	49	42	-8	41	1
123C 370737	13	-3	3	-1	-7	678	-20	-34	70	66	7	-26	27	-32	C	49	45	-6	44	-12
124 350735	17	-3	3	-1	-5	665	-19	-33	72	69	14	-24	31	-31	C	50	47	0	48	-10
125 320732	15	-3	3	-2	-7	649	-20	-39	73	70	19	-16	33	-34	C	48	49	4	47	-12
126 300730	16	-4	0	-7	-9	629	-21	-36	73	67	21	-25	32	-36	0	50	47	5	52	-17

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128 250725	15	-7	-3	-7	-10	586	-23	-39	74	69	31	-29	31	-39	C	50	50	14	52	-20
129 220722	14	-5	-5	-12	-10	563	-27	-40	74	68	37	-29	31	-42	C	52	49	22	52	-26
130 170717	17	-3	-4	-11	-12	518	-25	-39	79	72	46	-27	36	-43	C	56	53	32	55	-23
131 120712	15	-3	-7	-12	-15	473	-30	-40	82	75	52	-35	36	-44	C	55	54	39	56	-26
132 70707	13	-4	-7	-10	-15	427	-27	-42	82	72	61	-31	33	-47	C	55	50	45	57	-30
133 70707	17	-9	-3	-7	-11	445	-30	-46	90	74	61	-42	34	-42	C	50	57	39	50	-22
134 71207	19	0	3	-3	-5	437	-35	-52	94	75	62	-43	40	-46	C	56	60	45	52	-28
135 71707	16	8	7	3	2	430	-37	-55	97	78	60	-50	40	-49	C	57	63	45	48	-32
136 72207	17	14	13	10	11	427	-43	-59	102	84	61	-51	43	-52	C	60	66	47	48	-33
137 72507	17	21	19	12	13	418	-46	-61	102	85	61	-55	43	-57	C	65	66	50	49	-35
137A 202520	16	18	11	9	8	518	-46	-62	97	84	39	-55	41	-60	C	58	65	28	45	-36
138 202720	4513	21	17	13	12	520	-45	-66	100	85	41	-57	42	-60	C	60	68	30	47	-40
139 203020	19	27	21	17	15	514	-47	-66	103	88	42	-59	50	-62	C	65	70	32	45	-41
140 203220	18	29	23	20	21	512	-47	-68	104	89	40	-62	48	-65	C	65	73	31	45	-41
141 203520	17	36	29	27	28	510	-50	-69	104	91	43	-62	51	-64	C	69	70	33	45	-41
142 203720	20	48	32	33	34	509	-47	-69	110	95	41	-63	53	-67	C	70	74	34	46	-42
142A 173717	13	44	23	27	22	503	-59	-77	109	92	40	-69	53	-72	C	68	72	32	45	-52
142B 153715	19	50	27	32	28	487	-55	-76	112	95	45	-67	53	-73	C	68	77	36	47	-50
142C 153715	19	49	26	29	28	468	-56	-77	114	98	51	-67	56	-76	C	70	77	42	48	-50
143 153515	20	43	21	27	20	468	-55	-74	114	94	52	-67	57	-74	C	70	77	40	50	-49
144 153215	20	41	19	23	19	474	-55	-74	113	94	55	-65	53	-71	C	70	76	42	51	-50
145 153015	19	38	13	20	12	477	-55	-75	117	90	52	-64	55	-69	C	69	74	41	50	-51
146 152715	19	30	10	13	8	479	-52	-72	110	93	53	-63	53	-70	C	66	75	41	50	-49
147 152515	19	23	3	10	4	480	-50	-74	109	88	54	-63	53	-70	C	67	74	37	50	-49
147A 72507	20	28	3	10	4	411	-55	-73	112	90	67	-64	54	-71	C	68	75	53	56	-51
148 72207	20	23	1	8	2	417	-49	-70	111	93	69	-62	53	-70	C	69	74	52	57	-51
149 71707	19	13	-3	-4	-15	417	-51	-69	109	87	69	-59	51	-69	C	67	72	52	56	-49
150 71207	22	2	-17	-13	-20	425	-45	-65	106	85	79	-56	50	-66	C	60	72	51	59	-50
151 70707	21	-6	-24	-20	-28	430	-43	-61	104	82	71	-53	49	-64	C	60	69	50	60	-46
152 70707	19	-10	-22	-28	-32	435	-42	-62	110	89	79	-51	51	-61	C	65	70	55	65	-44
152A 120000	20	-7	-14	-18	-25	465	-45	-65	112	88	71	-55	50	-65	C	68	74	51	61	-45
153 170000	22	6	-1	-10	-17	504	-47	-69	114	90	61	-57	54	-66	C	70	75	45	62	-44
153A 220000	20	15	-2	-4	-10	539	-50	-72	116	90	52	-59	53	-72	C	69	75	35	60	-46
154 270000	22	22	8	6	-5	580	-55	-78	116	96	42	-64	55	-70	C	70	78	28	58	-49
154A 300000	13	27	13	12	5	605	-49	-82	115	96	35	-67	53	-69	C	70	78	20	52	-43
154B 320000	19	30	13	13	8	620	-55	-84	116	95	29	-68	52	-73	C	70	78	18	52	-48
154C 350000	21	37	19	20	12	636	-52	-93	104	98	26	-79	46	-72	C	60	76	10	55	-54
155 370000	20	42	24	28	19	659	-52	-89	101	97	22	-65	43	-69	C	57	76	2	53	-45
156 400000	20	50	30	32	25	719	-46	-92	93	92	15	-64	38	-62	C	54	70	-6	50	-37
156A 400000	18	51	33	37	25	788	-41	-92	84	90	14	-62	46	-59	C	48	61	-9	43	-31
157 420000	19	63	39	40	31	816	-40	-93	84	87	9	-62	32	-59	C	49	58	-14	44	-32
158 450000	19	52	101	-19	9	1657	-41	-112	107	115	-16	-65	53	-69	C	70	78	-46	40	-51
158A 450000	19	53	102	-17	11	1700	-40	-113	104	117	-18	-69	52	-70	C	70	77	-46	39	-50
158B 450000	19	53	104	-13	15	1715	-40	-116	104	120	-18	-69	53	-69	C	70	77	-46	39	-51
159 420000	20	52	101	-17	9	1688	-40	-110	107	118	-12	-68	53	-64	C	74	78	-41	40	-51
160 400000	20	49	101	-17	11	1658	-40	-111	104	118	-8	-67	52	-67	C	70	80	-37	41	-52
161 370000	19	42	93	-22	4	1620	-39	-112	109	116	-3	-69	53	-69	C	70	78	-32	45	-51
161A 370000	19	43	92	-24	3	1617	-41	-115	109	115	-2	-67	51	-70	C	70	76	-35	42	-56
161B 370000	18	42	104	-16	15	1657	-30	-102	108	115	-4	-62	53	-60	C	78	75	-32	43	-44
161C 370000	16	57	121	-8	31	1676	-26	-90	104	115	-6	-53	43	-42	C	79	65	-32	42	-25
161D 370000	17	56	116	-3	24	1660	-35	-90	109	115	-2	-57	43	-50	C	84	66	-28	52	-35
161E 370000	15	58	113	-2	22	1667	-32	-91	106	117	-2	-53	43	-50	C	80	66	-26	51	-36
162 350000	19	53	113	-2	24	1638	-28	-85	111	118	11	-49	47	-46	C	85	69	-22	56	-31
163 320000	16	47	108	-8	15	1597	-27	-87	107	117	10	-51	47	-46	C	80	67	-19	53	-31
164 270000	14	40	101	-11	12	1519	-26	-82	109	114	22	-45	43	-47	C	86	67	-8	60	-32
165 220000	12	31	92	-21	3	1424	-23	-77	106	110	32	-43	43	-44	C	85	64	-2	60	-27
166 170000	17	21	84	-27	-5	1325	-22	-71	110	115	44	-39	43	-42	C	85	65	12	68	-30
167 120000	17	13	78	-31	-10	1236	-18	-67	111	112	56	-37	47	-37	C	88	66	22	68	-25
168 70000	18	1	68	-37	-17	1138	-17	-62	114	113	69	-34	49	-37	C	87	64	34	73	-24
169 120000	16	9	72	-33	-11	1206	-18	-66	113	112	58	-35	48	-39	C	86	64	24	69	-26

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 1	CHAN 2	CHAN 3	CHAN 4	CHAN 5	CHAN 6	CHAN 7	CHAN 8	CHAN 9	CHAN 10	CHAN 11	CHAN 12	CHAN 13	CHAN 14	CHAN 15	CHAN 16	CHAN 17	CHAN 18	CHAN 19	CHAN 20
169A	120000	16	13	81	-28	-6	1205	-17	-66	117	115	62	-29	50	-39	C	89	67	25	72	-23
170	170000	17	23	87	-26	-1	1291	-20	-69	114	114	51	-32	49	-43	C	86	68	17	69	-26
171	220000	18	30	97	-18	5	1384	-20	-77	114	114	38	-37	45	-43	C	86	67	7	63	-29
171A	220000	13	41	107	-5	17	1398	-11	-67	116	114	34	-32	41	-32	C	88	60	2	62	-11
172	252222	16	37	101	-3	14	1446	-11	-67	114	110	32	-33	39	-37	C	87	60	-5	62	-12
172	272222	17	40	101	-12	12	1445	-10	-72	112	110	29	-33	40	-39	C	86	60	-6	61	-15
173	302222	17	37	95	-17	10	1484	-15	-73	111	110	28	-33	39	-42	C	84	60	-10	61	-16
174	322222	16	31	92	-19	5	1532	-19	-71	111	112	24	-35	36	-42	C	86	62	-15	60	-17
175	352222	13	23	82	-23	-2	1574	-17	-76	109	110	18	-42	38	-46	C	80	60	-21	58	-25
176	372222	18	23	81	-27	-5	1620	-16	-79	104	131	12	-45	38	-47	C	82	60	-28	58	-33
177	352222	17	23	83	-23	-3	1670	-16	-80	104	109	6	-39	38	-45	C	80	61	-33	56	-31
178	322222	20	26	88	-25	0	1635	-15	-82	109	112	16	-43	39	-44	C	83	65	-28	60	-29
179	302222	16	23	81	-27	-2	1593	-15	-82	109	110	17	-46	40	-49	C	84	62	-22	61	-34
180	272222	18	22	77	-31	-5	1539	-21	-82	109	110	22	-45	38	-51	C	84	64	-18	63	-39
181	252222	19	23	76	-31	-6	1490	-24	-80	112	116	29	-45	42	-51	C	84	66	-7	62	-40
182	222222	17	23	76	-31	-7	1440	-26	-82	113	115	34	-46	42	-54	C	87	65	-5	66	-39
183	222262	17	22	77	-30	-5	1395	-23	-82	113	115	39	-45	43	-54	C	87	65	2	66	-42
183A	222222	17	22	71	-37	-9	1390	-25	-84	117	118	33	-46	43	-59	C	88	69	4	70	-46
184	250000	-19	28	73	-34	-7	1431	-29	-86	118	119	37	-50	48	-60	C	87	70	-3	68	-49
185	270000	17	27	73	-37	-8	1472	-32	-92	114	118	32	-53	43	-65	C	87	69	-8	65	-53
186	300000	16	31	73	-34	-6	1512	-35	-94	116	120	26	-57	43	-70	C	85	69	-13	65	-59
187	320000	17	33	79	-33	-2	1558	-37	-100	116	120	22	-59	43	-72	C	87	70	-20	62	-59
188	350000	20	39	82	-30	0	1603	-39	-100	117	120	14	-57	46	-74	C	88	70	-23	62	-60
189	370000	17	42	86	-27	2	1650	-40	-102	114	119	10	-57	43	-74	C	84	69	-26	60	-61
189A	370000	17	43	90	-18	5	1656	-36	-101	117	120	9	-59	43	-69	C	85	75	-26	60	-56
189B	370000	15	62	143	26	48	1740	-15	-82	118	120	2	-43	40	-28	C	79	64	-38	46	-10
189C	370000	12	70	147	29	-1484	1759	-15	366	119	120	-2	-47	38	-29	C	80	64	-45	42	-12
189D	370000	15	76	156	33	55	1780	-11	-79	122	119	-4	-43	37	-27	C	80	65	-45	43	-3
189E	370000	16513	2304	2936	-962	-1214	5048	4926	14543	8908	-42	-1531	-1404	33	-8	C	84	57	-42	46	14
189F	370000	16	99	179	53	75	1780	-2	-63	120	118	2	-25	33	-6	C	85	59	-40	45	15
189F	370000	13	88	168	49	70	1770	2	-60	122	118	0	-27	32	-11	C	85	56	-41	51	13
189F	370000	12	83	163	48	69	1766	2	-60	121	117	0	-28	30	-10	C	84	56	-40	49	14
189G	370000	13	88	173	53	75	1773	4	-57	120	118	1	-25	29	-6	C	84	58	-42	52	19
189H	370000	12	89	168	53	73	1775	3	-59	121	115	0	-25	23	-9	C	80	56	-45	50	16
190	400000	13	92	173	61	76	1800	3	-59	121	117	-1	-25	20	-9	C	79	55	-47	50	4
191	420000	12	93	179	55	78	1840	-3	-64	119	115	-10	-29	23	-12	C	78	54	-56	45	10
192	450000	12	97	173	53	78	1884	-1	-69	114	110	-17	-33	21	-16	C	75	50	-65	41	9
193	470000	14	100	179	54	78	1947	-5	-70	113	110	-25	-33	20	-19	C	73	48	-71	38	8
193	470000	-137	101	179	56	77	1950	-5	-69	112	110	-26	-32	22	-16	C	70	48	-72	39	7
194	500000	11	103	181	53	81	2028	-2	-72	110	109	-36	-34	23	-16	C	70	46	-80	34	2
194	500000	13	103	185	56	83	2040	0	-72	110	108	-31	-35	19	-19	C	73	45	-90	34	5
195	300000	14	71	159	32	54	1479	3	-51	112	105	9	-20	21	-10	C	70	42	-40	49	11
196	400000	13	91	164	41	70	1367	3	-59	112	106	-13	-26	20	-14	C	70	43	-59	41	8
197	450000	13	95	169	44	72	1359	0	-65	112	107	-19	-31	20	-19	C	70	44	-69	41	3
198	500000	30480	102	177	51	75	2066	-3	-70	111	104	-33	-34	18	-22	C	68	40	-82	36	1
199	520000	31278	110	182	53	80	2173	-3	-74	111	105	-42	-35	18	-24	C	67	39	-90	30	1
199	520000	13	111	182	53	78	2229	-5	-74	109	104	-46	-37	16	-26	C	68	38	-91	29	-4
200	550000	13	111	189	70	81	2300	-8	-76	110	105	-55	-37	17	-28	C	66	35	-99	23	-4
200	550000	13	115	203	72	81	2341	-7	-75	108	100	-56	-40	18	-29	C	67	36	-103	25	-5
200	550000	11	121	606	73	75	2424	-8	-80	114	109	-60	-42	23	-33	C	69	43	-106	23	-11
200A	550000	13	122	641	72	75	2509	-11	-82	114	110	-63	-45	22	-35	C	68	38	-112	23	-12
200A	550000	13	120	673	73	83	3778	-15	-81	121	115	-67	-48	28	-39	C	77	41	-120	23	-20
200A	550000	13	122	1753	82	93	5650	-11	-80	119	115	-74	-45	26	-32	C	76	38	-120	9	-15
200A	550000	13	125	706	259	95	6377	-8	-76	119	112	-67	-42	26	-33	C	76	39	-111	12	-13
200A	550000	13	123	780	283	97	6523	-10	-79	120	114	-66	-42	23	-33	C	75	36	-110	10	-11
200B	550000	13	122	785	282	95	6355	-13	-80	119	112	-72	-44	23	-36	C	74	35	-117	3	-15
201	400000	12	97	723	259	77	6638	-5	-66	114	103	-40	-35	19	-28	C	70	29	-86	16	-9
202	200000	13	63	611	217	51	6080	1	-45	122	100	9	-23	23	-21	C	78	30	-38	33	1
202A	200000	12	72	633	241	69	6107	7	-45	124	100	9	-22	28	-9	C	74	24	-41	28	16
203	400000	10	88	681	253	80	6380	2	30700	123	104	-9	-29	23	-12	C	77	28	-62	20	5
204	400000	15	103	733	273	93	6687	4	-62	124	108	-35	-35	21	-15	C	74	27	-85	12	8

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 1	CHAN 2	CHAN 3	CHAN 4	CHAN 5	CHAN 6	CHAN 7	CHAN 8	CHAN 9	CHAN 10	CHAN 11	CHAN 12	CHAN 13	CHAN 14	CHAN 15	CHAN 16	CHAN 17	CHAN 18	CHAN 19	CHAN 20
205	500000	60	138	821	307	108	7016	2	-70	124	115	-60	-36	22	-19	C	75	33	-110	6	1
206	520000	12	127	835	313	105	7020	-5	-74	124	114	-80	-42	22	-24	C	74	30	-115	2	0
207	550000	11	133	878	328	108	7020	-7	-77	123	114	-80	-46	22	-27	C	74	30	-121	1	-7
208	570000	13	145	954	357	113	7020	-8	-83	123	110	-88	-50	21	-32	C	73	30	-132	0	-10
208	570000	13	140	1001	370	114	7020	-7	-80	124	110	-87	-47	23	-29	C	75	29	-126	-3	-9
208	570000	15	217	1019	378	118	7020	-7	-80	124	109	-86	-46	23	-28	C	75	29	-128	-4	-6
209	370000	13	182	912	342	88	7020	1	-66	123	100	-40	-37	23	-20	C	50	17	-87	7	-1
209	370000	12	179	905	337	87	7020	-3	-64	122	98	-40	-40	21	-21	C	70	19	-87	8	-1
210	500000	13	208	979	360	103	7020	-80	-75	124	105	-66	-45	19	-29	C	74	25	-113	1	-7
211	550000	12	218	1011	373	110	7020	-8	-80	123	107	-82	-49	21	-31	C	70	27	-126	-1	-9
212	570000	13	229	1050	390	114	7020	-11	-84	122	107	-88	-45	21	-40	C	72	27	-131	-4	-4
213	600000	19	1053	2484	773	121	7020	15	-84	133	112	-95	-43	31	-39	C	82	30	-140	-2	-5
213	600000	13	1223	2492	820	135	7020	17	-76	134	114	-97	-49	31	-42	C	80	30	-144	-4	-13
213	600000	19	1242	2492	825	135	7020	17	-75	134	113	-98	-49	31	-37	C	82	30	-143	-5	-15
213	600000	19	1300	2509	838	144	7020	17	-73	137	112	-100	-50	33	-36	C	84	30	-143	-4	-12
214	620000	18	1358	2585	890	755	7020	17	-77	130	115	-113	-47	29	-38	C	78	30	-155	-10	-9
214	620000	17	1442	2613	1010	780	7020	16	-75	130	115	-115	-49	28	-36	C	77	30	-154	-10	-12
215	650000	20	1643	3151	1178	1000	7020	12	-83	132	120	-126	-59	30	-43	C	78	37	-173	-12	-23
215	650000	20	1659	3178	1192	1023	7020	9	-89	132	119	-128	-62	31	-44	C	80	38	-173	-12	-24
216	670000	19	1744	3281	1442	1327	7020	0	-93	134	127	-151	-77	36	-52	C	80	40	-186	-18	-30
216	670000	20	1782	3296	1543	1359	7020	0	-91	135	128	-135	-77	35	-50	C	82	40	-189	-17	-25
216	670000	20	1788	3309	1589	1388	7020	0	-93	138	130	-137	-77	37	-51	C	80	43	-191	-18	-27
217	700000	22	1993	3701	1677	1491	7020	-3	-99	143	140	-150	-82	39	-54	C	90	50	-206	-22	-34
217	700000	21	2023	3773	1721	1635	7020	-5	-99	142	143	-156	-82	41	-59	C	88	50	-210	-27	-35
218	720000	18	2255	3760	1957	1983	7020	-11	-100	149	157	-185	-87	47	-59	C	95	58	-227	-27	-35
219	750000	20	2347	5783	2001	2142	7020	-9	-102	154	164	-190	-86	51	-59	C	100	66	-242	-59	-22
219	750000	60	2435	3813	2037	2236	7020	-9	-100	158	174	-198	-89	55	-62	C	106	73	-247	-69	-7
220	770000	18	2470	3771	2126	2350	7020	-6	-101	161	187	-215	-90	60	-62	C	110	85	-263	-89	1
220	770000	17	2564	3808	2141	2350	7020	-8	-109	160	195	-221	-87	59	-66	C	110	89	-275	-99	4
221	400000	23	1863	3016	1642	1763	7020	21	-48	164	157	-118	-43	56	-11	C	87	46	-167	-76	45
222	600000	22	2253	3451	1932	2108	7020	11	-72	170	185	-170	-57	61	-24	C	95	68	-220	-88	38
223	750000	25	2542	3763	2166	2384	7020	13	-90	178	226	-229	-62	72	-36	C	108	96	-278	-112	41
224	770000	22	2655	3770	2185	2376	7020	10	-99	180	240	-249	-63	73	-42	C	110	102	-302	-121	38
225	800000	20	2638	3616	2216	2377	7020	6	-110	184	269	-266	-79	78	-52	C	126	128	-322	-128	26
226	820000	53	2654	-557	2364	2410	6111	206	30865	184	297	-285	-77	81	-59	C	139	150	-337	-152	38
226	820000	21	2675	3442	2316	2125	7020	15	-109	194	310	-291	-76	88	-54	C	156	158	-349	-160	117
226	820000	23	2673	3452	2323	2329	7020	9	-113	191	305	-286	-74	89	-59	C	157	156	-343	-160	146
226	820000	21	2692	3453	2319	2334	7020	8	-111	192	306	-288	-75	90	-59	C	159	160	-349	-162	154
227	850000	20	2850	3383	2393	2334	7020	23	-125	196	337	-316	-71	78	-54	C	157	190	-405	-178	288
227	850000	19	2854	3321	2389	2320	7020	29	-121	184	303	-205	-79	63	-32	C	119	110	-272	-132	306
227	850000	22	2513	3130	2274	2235	7020	23	-114	191	277	-130	-67	60	-19	C	126	116	-215	-107	308
227	850000	20	2412	2981	2203	2145	7020	31	-84	189	238	-65	-56	51	6	C	129	116	-151	-102	318
228	550000	19	2262	2706	2085	2035	7020	44	-64	164	201	47	-28	27	428	C	86	124	45	108	350
228	550000	16	2008	2628	1981	1975	7020	105	-24	150	188	64	3	11	1197	C	177	134	115	183	377
229	540000	18	2087	2632	1966	1967	7020	111	-26	148	185	74	1	3	1269	C	210	120	140	210	384
229A	540000	19	2030	2638	1966	1967	7020	112	-25	147	185	78	-2	6	1268	C	210	124	140	212	383
230	600000	20	2332	3118	2150	2145	7020	1229	-20	204	173	62	-45	62	2374	C	7930	149	137	389	841
231	660000	21	2511	3323	2281	2304	7020	1392	-276	196	142	72	-35	61	2458	-4986	7930	7930	102	351	1487
232	710000	20	2592	3287	2427	2343	7020	1572	51	194	163	73	-17	63	2458	-5727	7930	7930	-20	332	1829
233	608282	22	2530	3379	2497	2322	7020	1587	36	212	178	79	-32	75	2444	-5776	7930	7930	-57	326	1811
234	608585	22	2588	3419	2472	2336	7020	1583	33	210	178	82	-33	73	2454	-5788	7930	7930	-50	327	1805
235	608787	21	2583	3505	2493	2359	7020	1583	31	209	178	82	-37	72	2468	-5821	7930	7930	-45	332	1801
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237	609292	13	2561	3470	2363	2364	7020	1579	28	201	166	86	-42	63	2497	-5900	7930	7930	-33	335	1781
238	609593	15	2723	3673	2430	2432	7020	1623	28	203	167	88	-37	57	2488	-5946	7930	7930	-22	339	1769
239	609696	14894	-457	2229	7033	2142	2737	5905	3866	-210	267	100	-29	70	2490	-5934	7930	7930	-16	347	1782
239	609696	17	2431	6933	2560	2483	7020	1631	45	211	169	97	-34	69	2489	-5936	7930	7930	-16	346	1786
239	0	17	2541	6933	2630	2483	7020	1630	47	211	168	97	-37	67	2489	-5935	7930	7930	-18	347	1785
239	0	19	2595	6933	2881	2491	7020	1638	48	210	170	97	-33	69	2482	-5935	7930	7930	-20	347	1786
239	0	24	7384	6933	7033	6735	7020	1659	56	214	178	104	-29	72	2483	-5930	7930	7930	-16	352	1794
239	0	22	7503	6933	7033	6735	7020	1660	54	214	174	99	-34	68	2460	-5931	7930	7930	-29	342	1787

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2	101010	3	2	-1	-1	8	2	-5	3	-2	-1	-1	-1	1	2	2	0	-4	-5	2	1
2A	101010	1	2	0	-1	7	3	-3	3	-2	-2	0	-1	1	0	1	0	1	-5	2	0
3	121212	6	4	-1	-3	7	1	-5	4	-1	-3	5	-5	-3	9	-1	-1	-4	-5	4	-1
3A	121212	5	2	-1	-1	8	4	-7	3	-2	-2	0	-3	-2	1	1	0	-4	-5	3	0
4	151515	10	4	0	-2	9	4	-9	4	-1	-2	5	-2	-2	2	2	2	-5	-5	1	-1
4A	151515	11	5	0	-1	10	4	-9	4	3	-2	4	-3	0	2	2	0	-6	-5	2	-2
5	171717	12	4	-2	-3	10	4	-13	0	-2	-1	6	-3	-1	1	1	0	-9	-5	1	-3
5A	171717	16	4	-1	-3	7	4	-14	0	-3	-2	6	-4	-1	1	2	1	-9	-5	3	-4
6	202020	33	4	5	1	9	9	-17	4	4	-1	8	-6	6	1	6	2	-9	-5	2	0
6A	202020	23	5	0	-2	11	4	-17	6	-2	-2	8	-4	1	0	3	-1	-12	-5	1	-3
7	222222	25	6	3	-1	15	6	-19	6	-2	-1	10	-9	1	-3	3	-2	-12	-5	-1	-4
7A	222222	23	6	3	-2	12	6	-23	5	-2	-1	10	-9	-2	-1	4	-2	-15	0	-2	-5
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10A	70707	34	1	2	-1	10	2	-5	-1	0	-1	5	-2	2	3	1	1	0	0	3	0
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23	70707	55	21	27	22	34	24	17	20	24	25	25	21	25	28	31	27	31	30	34	28	28
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26	70707	56	25	25	21	33	20	16	19	20	21	20	19	19	29	25	22	29	25	37	23	23
27	100710	65	23	24	22	34	22	13	22	23	21	21	18	17	33	24	26	31	25	39	23	23
27	100710	73	22	23	18	32	24	14	23	21	20	20	17	16	30	23	27	32	23	39	20	20
28	120712	76	22	20	19	34	24	8	24	19	20	20	13	15	35	20	27	31	24	36	20	20
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29	130715	93	22	20	19	31	23	2	25	22	20	24	14	15	37	22	31	31	22	40	20	20
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30	170717	90	22	20	17	32	24	-3	27	17	19	25	11	12	40	19	32	31	22	41	18	18
30	170717	61	23	18	18	33	24	0	26	18	19	20	11	12	43	20	35	34	23	43	20	20
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37	100710	69	25	20	16	37	24	13	20	18	18	20	17	13	35	20	29	29	22	39	17
37	100710	61	27	20	17	33	29	13	22	19	18	19	20	14	35	18	30	29	22	43	16
38	70707	71	27	27	26	37	30	18	20	25	21	24	23	22	38	30	27	32	28	43	27
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52	71007	121	20	31	23	31	21	7	18	25	23	15	11	21	26	27	15	23	25	44	20
53	71207	126	21	27	22	34	22	12	19	24	22	18	13	23	25	30	15	21	28	44	20
53	71207	129	20	24	20	33	23	11	18	20	20	17	16	19	24	27	15	23	28	44	22
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54	71507	137	22	23	16	37	24	14	18	18	17	17	16	24	20	28	14	25	24	45	18
55	71707	132	23	19	14	37	24	17	17	18	14	18	16	18	20	26	12	19	22	43	17
55	71707	131	22	17	11	37	28	18	16	15	15	17	13	22	19	25	12	16	21	43	19
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61	71207	113	27	14	9	40	31	28	16	17	10	18	20	19	25	23	19	26	17	51	17
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1A	70707	113	24	13	8	34	24	15	23	13	6	16	18	9	35	10	26	33	13	54	10
2A	101010	109	26	11	7	37	28	16	27	11	6	20	20	9	37	13	28	31	10	56	10
3A	121212	116	29	9	5	37	32	11	26	11	6	18	20	7	37	13	30	30	8	56	10
4A	151515	103	28	6	4	39	32	7	28	8	5	19	19	8	37	11	27	28	10	55	9
5A	171717	116	30	5	2	40	36	8	29	7	3	19	19	7	38	12	28	26	9	56	7
6A	202020	98	32	5	0	40	33	5	30	7	2	23	19	9	38	12	31	23	8	56	7
7A	222222	101	31	4	-1	43	34	1	34	5	3	20	18	5	38	11	29	21	7	59	7
8A	202020	111	31	5	-1	40	37	3	31	7	1	20	17	7	38	11	29	24	9	59	6
9A	171717	109	31	3	3	42	34	8	30	6	0	20	18	5	40	11	32	26	10	62	5
10A	151515	421	29	2	0	38	32	9	28	5	2	18	17	6	38	8	27	29	9	59	7
11A	121212	126	29	2	-1	39	32	12	28	5	1	17	18	4	37	8	30	29	9	60	6
12A	101010	126	23	5	2	36	29	16	25	5	0	10	20	6	39	8	31	32	10	59	6
13A	70707	593	22	3	4	37	31	17	25	12	7	10	21	5	39	11	29	33	12	56	8
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77	121212	85	28	20	11	47	34	8	31	15	11	25	22	15	43	22	32	36	18	71	17
77A	151515	103	32	20	15	50	35	7	32	13	10	29	23	17	47	23	36	34	19	72	15
78	171717	99	34	17	8	50	37	8	34	13	10	30	25	15	46	21	35	31	15	70	10
78A	202020	90	32	14	7	52	39	6	35	8	10	30	23	14	45	20	35	29	14	71	10
79	222222	76	37	12	6	56	40	3	39	8	8	30	25	14	47	22	38	29	14	72	9
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80A	252525	71	37	7	4	55	40	2	40	9	7	30	21	9	47	21	37	26	15	75	7
81	272727	74	39	4	2	57	42	-3	40	1	5	35	21	9	46	18	38	26	10	74	6
81A	272727	75	40	3	0	57	44	-3	40	3	3	35	23	9	45	17	37	24	9	74	8
82	303030	86	37	5	3	56	44	-2	46	3	5	35	24	9	45	18	37	26	10	76	10
82A	303030	91	36	6	-3	56	44	-2	42	3	2	37	24	9	45	13	35	26	10	74	8
83	323232	66	37	3	-1	53	44	-5	44	3	3	38	25	8	44	18	36	23	9	76	5
83A	323232	96	38	6	1	56	46	-6	46	4	1	39	24	8	47	15	36	23	10	76	7
84	353535	80	41	5	-1	59	47	-10	50	6	5	43	24	7	47	21	40	23	12	80	10
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84C	333535	103	39	5	-2	55	49	-11	49	4	2	41	26	8	45	16	38	22	11	80	7
85	373737	116	39	5	-4	55	50	-18	53	4	3	42	25	8	45	19	37	21	9	80	5
85A	373737	102	37	4	-3	56	49	-15	50	5	1	43	24	7	43	20	37	19	13	79	7
86	353535	103	36	3	-1	55	51	-13	49	6	2	40	24	4	44	19	36	24	12	81	6
87	323232	96	34	3	-4	50	46	-12	50	5	1	39	25	4	44	16	39	25	7	81	8
88	303030	115	32	0	-2	52	44	-8	47	5	2	39	27	3	47	17	40	26	11	79	8
89	272727	654	37	7	0	54	44	-5	47	7	5	37	28	5	48	16	38	30	11	84	7
90	252525	25	32	4	-1	52	43	-3	45	4	3	34	28	3	48	13	38	33	10	79	7
91	222222	23	32	5	-1	50	42	-2	42	8	2	33	28	4	49	12	36	34	8	80	7
91A	202020	25	33	5	-1	50	44	2	44	7	4	35	30	4	50	13	39	36	10	81	10
92	171717	25	42	7	2	50	43	8	42	8	5	33	30	4	52	13	39	38	11	83	9
92A	151515	25	32	7	0	50	40	11	40	7	3	34	31	6	55	15	41	41	13	83	8
93	121212	25	30	5	-1	50	41	14	38	6	3	30	31	4	55	10	41	45	13	83	10
94	70707	28	30	7	-1	48	41	21	37	7	7	28	35	2	55	11	42	47	11	83	10
95	70707	47	31	23	14	49	34	15	36	17	15	21	31	9	55	18	34	44	21	86	17
95A	121212	33	25	20	14	51	39	11	37	15	13	28	29	10	52	21	34	39	20	86	15
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96A	222222	53	31	15	6	58	44	0	45	13	9	36	33	9	50	16	34	36	15	91	10
97	272727	55	32	15	7	56	49	-5	48	12	9	39	28	7	50	18	32	34	15	90	8
97A	323232	15	31	11	2	58	50	-11	50	7	9	35	27	5	50	20	37	26	15	91	8
97B	353535	15	37	9	-1	60	52	-14	54	5	5	39	28	4	50	17	37	28	15	91	9
98	373737	14	36	10	-1	57	53	-20	55	6	4	43	28	5	48	17	38	25	15	93	6
99	373232	20	31	5	-4	58	50	-22	54	-2	-3	45	21	-4	53	10	41	31	13	89	8
100	372727	22	32	4	-6	57	47	-25	55	-2	-1	42	24	-11	60	3	42	34	11	90	8
100A	372727	22	32	4	-7	59	47	-22	55	-4	0	44	24	-11	60	3	45	34	13	90	8
100B	372727	13	37	-5	-11	57	44	-24	56	-9	-7	45	21	-14	63	-1	47	34	10	94	5
100C	372727	12	33	-7	-11	58	44	-25	56	-9	-5	45	24	-16	60	-3	45	34	9	93	3
101	372222	15	30	-6	-11	56	44	-25	56	-6	-7	45	23	-19	68	-4	52	36	7	93	7
101A	372222	15	32	-2	-11	56	47	-27	58	-7	-5	44	21	-19	69	-3	50	36	8	93	7
102	371717	14	28	-4	-4	50	43	-30	55	-5	-2	40	19	-23	75	-4	54	42	10	94	8
102A	371717	16	31	-1	-7	54	42	-29	57	-5	-1	40	19	-25	76	-6	58	44	11	94	6
102B	371515	20	31	-1	-4	51	40	-28	57	-7	-3	43	20	-26	79	-8	61	44	12	95	8
102C	371515	25	30	0	-6	54	42	-27	59	-4	-3	41	20	-27	80	-7	61	46	11	95	7
103	371212	31	28	0	-6	54	40	-30	58	-4	-3	41	21	-31	83	-10	65	47	12	96	8
103A	371212	23	29	0	-5	54	42	-29	58	-6	1	40	20	-29	83	-9	64	50	12	94	9
103B	371010	29	29	0	-2	52	42	-32	58	-2	0	40	17	-31	89	-11	67	51	14	95	7
103C	371010	21	31	1	-3	53	41	-31	59	-3	3	40	20	-31	89	-9	65	50	13	95	8
104	370707	16	25	1	-3	49	39	-33	58	-3	-1	37	18	-32	90	-12	70	51	11	96	9
104A	370707	22	27	1	-4	51	40	-32	58	-5	-1	38	16	-33	92	-12	70	53	13	95	7
105	370707	45	27	3	-1	51	42	-22	58	-4	2	38	24	-29	88	-9	65	53	9	92	9
106	270707	57	29	-3	-4	51	39	-14	53	-6	0	38	23	-26	84	-10	62	51	9	98	8
107	220707	13	31	-5	-3	54	41	-5	52	-2	2	38	28	-21	78	-7	60	54	11	101	8
108	150707	20	32	-1	-3	57	44	13	46	0	3	35	36	-14	73	-2	51	56	12	103	10
109	70707	22	37	-6	-3	58	44	25	40	1	2	36	41	-9	66	1	48	56	12	100	9
114A	70707	11	35	17	14	79	54	28	50	12	20	47	56	7	81	13	57	69	24	136	20
115	120712	11	32	15	14	77	54	18	54	13	21	49	54	3	86	11	61	71	23	140	20
116	170717	12	36	14	12	77	53	11	57	15	19	50	51	-1	90	9	67	71	20	142	18
117	220722	13	35	16	9	78	58	4	60	8	17	50	50	-5	95	6	72	73	17	141	14
118	250725	11	39	14	7	77	58	-2	64	7	16	54	50	-6	98	3	72	74	19	144	14
119	270727	13	35	13	7	75	53	-7	64	7	14	50	47	-9	103	3	75	74	15	146	10
120	300730	15	34	12	9	77	57	-12	68	5	10	57	45	-13	105	-1	77	75	14	146	10
121	320732	30	32	13	9	76	58	-16	73	4	15	54	41	-14	109	2	83	76	15	146	8
122	350735	11	34	15	12	76	61	-22	75	6	14	50	42	-18	110	3	83	76	15	152	8
123	370737	11	34	15	10	76	59	-25	78	7	13	50	40	-21	116	2	88	81	18	151	7
123A	400740	11	31	10	6	73	59	-27	79	1	8	50	37	-25	118	-2	88	81	13	153	7
123B	370737	11	32	9	6	74	60	-27	76	1	10	50	36	-24	113	-3	87	81	9	153	5
123C	370737	10	32	7	-1	75	61	-25	78	-5	4	50	41	-27	117	-7	91	83	5	156	0
124	350735	12	35	9	1	76	61	-22	80	-6	5	50	43	-28	116	-10	90	83	5	157	1
125	320732	16	36	9	-4	77	64	-17	78	-7	1	50	48	-28	113	-11	89	86	8	159	0
126	300730	16	39	-1	-4	77	64	-12	74	-12	-3	50	45	-26	110	-11	87	85	5	159	5

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 21	CHAN 22	CHAN 23	CHAN 24	CHAN 25	CHAN 26	CHAN 27	CHAN 28	CHAN 29	CHAN 30	CHAN 31	CHAN 32	CHAN 33	CHAN 34	CHAN 35	CHAN 36	CHAN 37	CHAN 38	CHAN 39	CHAN 40
127	270727	16	42	-5	-3	78	64	-6	73	-9	-1	50	49	-24	110	-13	87	84	5	158	2
128	250725	20	40	-7	-11	78	64	-2	70	-13	-4	49	51	-25	110	-10	84	86	4	156	4
129	220722	34	41	-10	-12	76	64	4	68	-15	-6	48	50	-26	107	-13	82	85	3	156	4
130	170717	53	45	-11	-12	80	64	17	67	-13	-5	47	56	-23	104	-13	80	83	0	159	0
131	120712	46	45	-10	-13	80	64	23	62	-13	-5	48	60	-18	101	-10	77	85	4	159	7
132	70707	35	47	-14	-16	80	66	33	58	-13	-7	45	64	-15	97	-9	72	83	4	159	5
133	70707	49	44	-12	-13	78	59	30	55	-16	-11	39	61	-21	93	-14	68	73	-5	156	-6
134	71207	39	47	-14	-17	82	61	35	53	-20	-11	42	63	-21	88	-10	65	73	-5	159	-5
135	71707	39	51	-20	-18	80	66	38	50	-21	-13	46	64	-16	82	-9	60	66	-5	156	-5
136	72207	42	52	-22	-22	87	66	43	50	-22	-13	48	66	-14	78	-10	59	62	-7	157	0
137	72507	42	55	-24	-23	86	64	42	49	-24	-16	48	66	-11	75	-7	57	61	-6	156	-4
137A	202520	56	51	-20	-24	84	64	20	58	-22	-15	50	61	-21	86	-12	67	61	-9	161	-10
138	202720	61	52	-22	-23	88	68	21	59	-24	-19	54	64	-19	85	-10	65	63	-7	163	-10
139	203020	73	56	-25	-26	87	72	23	60	-24	-20	56	63	-21	81	-12	64	61	-7	162	-9
140	203220	59	58	-25	-24	92	72	26	60	-26	-17	56	64	-16	79	-7	64	59	-6	161	-6
141	203520	35	59	-20	-24	95	74	27	60	-22	-20	58	68	-13	78	-7	62	57	-7	163	-6
142	203720	36	61	-21	-24	97	78	28	60	-22	-17	59	66	-12	77	-4	61	56	-6	160	-6
142A	173717	49	60	-30	-33	93	73	26	58	-28	-23	57	65	-21	75	-11	59	52	-10	158	-12
142B	153715	38	62	-27	-31	95	74	31	59	-23	-23	57	68	-17	75	-7	59	54	-8	161	-12
142C	153715	28	64	-27	-28	98	77	37	58	-23	-23	58	71	-15	73	-8	58	55	-6	162	-9
143	153515	29	64	-27	-27	96	74	37	57	-23	-23	58	70	-14	75	-7	58	56	-7	163	-10
144	153215	36	62	-29	-28	96	76	37	58	-25	-23	56	71	-17	80	-8	60	60	-7	164	-10
145	153016	31	62	-28	-26	95	74	37	59	-24	-21	57	69	-21	80	-11	64	62	-7	165	-11
146	152715	33	62	-27	-30	90	73	34	58	-25	-21	56	69	-21	87	-14	67	64	-8	165	-13
147	152515	32	59	-23	-29	90	72	31	60	-23	-22	51	66	-25	84	-13	67	65	-8	165	-12
147A	72507	35	62	-30	-28	95	72	44	54	-26	-23	50	71	-21	80	-12	62	64	-8	164	-11
148	72207	36	62	-27	-28	92	72	46	55	-26	-21	48	69	-23	85	-14	65	69	-8	165	-13
149	71707	39	60	-27	-26	90	70	44	57	-24	-20	47	70	-31	90	-18	69	74	-8	166	-11
150	71207	36	60	-22	-25	89	71	43	60	-23	-20	47	71	-31	100	-19	77	78	-10	168	-11
151	70707	31	57	-23	-25	88	68	38	60	-24	-20	46	70	-33	103	-22	77	83	-9	171	-13
152	70707	29	62	-24	-26	98	76	47	65	-25	-25	50	79	-33	114	-27	86	92	-17	183	-16
152A	120000	30	62	-29	-29	98	77	38	65	-28	-30	54	79	-33	114	-27	87	86	-18	186	-18
153	170000	31	64	-24	-28	100	81	31	70	-30	-25	58	76	-33	112	-25	85	84	-2	184	-20
153A	220000	32	64	-26	-31	101	80	26	74	-29	-28	60	75	-37	110	-23	84	81	-20	184	-20
154	270000	29	67	-30	-31	105	82	20	78	-27	-29	60	73	-34	108	-22	85	76	-18	185	-20
154A	300000	33	61	-24	-28	100	83	13	77	-25	-30	63	70	-34	106	-19	82	74	-19	185	-22
154B	320000	41	62	-24	-34	104	84	8	79	-32	-29	63	71	-35	104	-23	81	70	-25	184	-23
154C	350000	52	57	-32	-41	97	84	0	84	-37	-31	63	68	-33	98	-19	80	71	-16	184	-22
155	370000	48	55	-24	-38	96	83	-9	85	-32	-30	65	67	-35	98	-18	81	66	-18	184	-22
156	400000	54	47	-17	-32	95	79	-15	92	-26	-27	63	61	-32	90	-17	80	66	-16	184	-20
156A	400000	52	42	-13	-31	91	72	-22	87	-25	-25	61	59	-34	89	-17	74	64	-18	182	-21
157	420000	51	46	-11	-28	89	73	-29	90	-22	-27	65	57	-31	89	-17	76	64	-12	185	-20
158	450000	41	65	-49	-48	131	67	-57	67	33	837	146	-19	-64	39	-19	71	76	-7	197	-20
158	450000	41	66	-53	-51	132	64	-62	64	79	869	149	-22	-64	37	-17	71	76	-6	196	-21
158	450000	40	66	-52	-48	133	67	-62	65	98	880	147	-24	-62	35	-19	71	78	-6	195	-21
159	420000	34	67	-55	-48	131	64	-59	64	108	879	148	-22	-63	38	-19	72	80	-5	196	-21
160	400000	33	68	-54	-49	131	64	-52	64	112	869	145	-19	-62	39	-21	71	80	-6	195	-21
161	370000	33	67	-51	-51	134	64	-49	60	114	859	149	-17	-63	39	-23	71	81	-8	195	-22
161A	370000	31	66	-53	-53	135	64	-50	60	114	859	146	-17	-61	38	-27	72	84	-10	198	-23
161B	370000	34	68	-47	-43	135	64	-50	59	132	873	149	-16	-54	40	-19	74	85	-8	199	-20
161C	370000	36	62	-37	-35	140	64	-53	60	153	889	153	-12	-51	40	-11	77	86	3	204	-12
161D	370000	35	62	-42	-44	138	63	-52	60	147	885	153	-11	-49	41	-17	81	90	0	206	-12
161E	370000	31	66	-43	-43	140	69	-49	60	151	888	150	-11	-51	45	-14	82	90	-1	210	-12
162	350000	33	67	-44	-38	143	74	-43	60	153	883	150	-7	-48	48	-13	84	96	3	213	-11
163	320000	32	64	-43	-41	133	71	-44	57	153	876	150	-6	-47	47	-13	84	96	2	211	-12
164	270000	34	64	-40	-38	139	70	-33	58	155	857	146	2	-43	50	-17	88	101	1	211	-12
165	240000	30	67	-40	-36	137	69	-23	52	156	833	143	2	-43	56	-14	86	105	0	211	-12
166	170000	31	68	-37	-34	135	73	-12	50	163	806	134	11	-41	62	-17	92	109	-2	213	-10
167	120000	33	70	-40	-33	137	71	-3	48	162	772	130	20	-41	65	-14	92	114	-2	213	-13
168	70000	32	70	-37	-31	137	72	12	46	161	749	127	27	-39	70	-15	98	114	-4	214	-17
169	120000	33	71	-36	-31	139	72	-3	48	162	765	129	21	-39	69	-14	96	111	-5	212	-12

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 21	CHAN 22	CHAN 23	CHAN 24	CHAN 25	CHAN 26	CHAN 27	CHAN 28	CHAN 29	CHAN 30	CHAN 31	CHAN 32	CHAN 33	CHAN 34	CHAN 35	CHAN 36	CHAN 37	CHAN 38	CHAN 39	CHAN 40
169A	169000	32	72	-41	-33	140	74	-5	60	161	764	130	24	-41	70	-13	96	113	-3	212	-15
170	170000	33	69	-44	-33	140	74	-5	60	159	787	136	17	-40	65	-14	92	109	-5	214	-18
171	171000	33	67	-41	-33	140	73	-19	55	160	816	138	10	-42	60	-13	92	108	-5	216	-13
171A	171000	35	66	-33	-32	140	72	-25	50	168	827	140	8	-35	60	-1	95	104	5	220	-10
172	172222	35	64	-30	-23	140	71	-29	54	168	848	139	6	-36	63	-5	92	104	3	221	-11
172	172222	35	64	-31	-26	140	69	-29	52	168	845	141	4	-37	63	-6	96	104	5	222	-11
173	172222	36	62	-32	-25	140	72	-35	57	169	854	144	4	-38	65	-9	99	106	5	221	-10
174	172222	36	61	-33	-27	140	70	-39	59	166	869	145	1	-42	68	-10	102	106	4	223	-10
175	172222	1676	61	-33	-31	140	70	-45	60	164	881	148	-2	-46	69	-13	102	105	2	225	-10
176	172222	36	61	-34	-31	140	70	-52	60	168	893	147	-9	-51	70	-17	104	105	3	226	-12
177	172222	35	59	-33	-31	140	72	-56	63	178	924	150	-10	-54	77	-18	107	106	3	226	-10
178	172222	36	64	-33	-31	143	72	-61	63	180	909	150	-7	-51	74	-19	107	109	3	226	-11
179	172222	36	66	-40	-36	142	72	-64	59	176	899	148	-5	-51	70	-18	104	105	2	226	-12
180	172222	36	67	-40	-37	140	71	-62	60	177	884	148	0	-48	69	-19	103	106	0	226	-13
181	172222	39	67	-40	-36	142	72	-34	58	175	869	146	1	-46	69	-18	101	109	-1	226	-15
182	222222	39	69	-41	-39	142	74	-27	56	177	856	144	5	-43	68	-17	101	108	-2	226	-15
183	222222	40	70	-42	-37	145	77	-19	55	177	838	142	9	-42	63	-17	99	108	-5	228	-17
183A	222222	41	69	-44	-43	145	74	-22	55	176	834	140	8	-45	67	-20	102	111	-7	233	-18
184	250000	43	70	-47	-44	144	74	-34	58	173	843	145	9	-48	66	-22	100	109	-7	232	-21
185	270000	41	69	-50	-48	145	74	-39	57	171	853	149	7	-49	63	-23	97	105	-10	231	-21
186	300000	41	68	-53	-49	142	76	-36	60	169	864	148	5	-51	63	-22	96	103	-8	230	-24
187	320000	42	69	-54	-51	143	76	-40	59	168	877	150	-1	-53	60	-23	95	102	-10	231	-23
188	350000	40	68	-55	-47	144	74	-43	62	168	894	155	-2	-52	58	-22	92	96	-11	230	-24
189	370000	45	69	-56	-47	145	79	-44	63	167	911	150	-9	-53	57	-27	92	97	-14	229	-23
189A	370000	41	70	-60	-41	147	77	-50	65	178	928	150	-9	-58	55	-19	92	99	-5	232	-22
190A	370000	21	60	-39	-29	145	68	-62	56	208	951	149	-14	-43	45	-4	84	86	5	225	-12
190C	370000	15	57	-29	-27	143	64	-65	56	218	964	150	-20	-41	40	0	83	85	9	228	-10
190C	370000	15	59	-25	-25	145	64	-68	57	230	979	149	-22	-38	40	3	82	83	15	232	-5
190E	370000	16	62	-18	-15	143	66	-68	59	245	985	152	-19	-28	40	13	89	88	24	240	4
190F	370000	16	62	-12	-12	150	68	-67	59	242	986	150	-19	-28	42	13	89	89	25	240	6
190F	370000	20	62	-12	-12	148	69	-68	58	247	985	149	-18	-25	43	13	92	91	23	243	6
190F	370000	1693	62	-10	-13	148	69	-70	57	246	984	150	-19	-26	43	13	90	94	23	244	7
190G	370000	19	69	-7	-11	147	70	-69	58	254	989	152	-16	-21	45	18	92	91	25	245	8
190H	370000	16	66	-7	-11	146	64	-75	58	252	989	150	-21	-23	41	16	88	87	28	246	6
190A	370000	17	70	-11	-12	147	64	-80	60	251	1008	149	-22	-24	44	16	89	89	29	248	9
191	420000	17	68	-14	-11	145	64	-84	60	264	1009	150	-29	-25	38	13	87	86	28	246	7
192	450000	16	65	-16	-14	147	59	-93	60	278	1060	156	-32	-27	36	16	86	85	31	246	8
193	470000	19	64	-16	-11	147	56	-102	58	308	1112	158	-43	-29	33	14	82	82	30	246	9
193	470000	16	65	-16	-11	145	56	-102	58	312	1117	157	-44	-27	30	13	82	83	31	248	10
194	500000	16	65	-15	-12	147	50	-112	55	348	1173	163	-52	-31	30	-587	79	81	32	244	9
194	500000	19	65	-17	-11	145	51	-113	55	364	1179	160	-53	-31	30	15	80	83	32	246	13
195	530000	16	63	-16	5409	164	57	-71	43	384	1089	147	-41	-28	15	91	96	88	28	246	10
196	480000	16	62	-17	5409	164	54	-92	50	381	1140	155	-39	-21	40	13	87	90	29	246	10
197	430000	19	61	-20	5409	167	57	-100	50	378	1167	160	-44	-24	36	14	86	85	27	244	10
198	500000	16	60	-21	5409	169	53	-113	52	402	1226	166	-58	-26	33	14	81	82	31	244	10
199	550000	16	58	-24	5409	170	51	-124	50	506	1297	170	-68	-31	28	17	80	78	33	245	13
199	520000	17	58	-27	5409	170	50	-127	48	574	1337	169	-73	-32	28	13	78	76	35	241	15
200	550000	18	33	-30	5409	175	44	-138	47	643	1403	172	-85	-32	25	12	78	76	35	241	19
200	550000	21	38	-30	5409	177	44	-142	45	688	1433	170	-88	-33	25	12	77	76	39	239	20
200	550000	20	40	-33	5409	180	47	-150	52	792	1505	168	-98	-36	24	13	77	76	41	239	20
200A	550000	18	41	-32	5409	180	50	-155	52	817	1533	165	-103	-38	22	13	76	76	42	238	20
200A	550000	20	36	-44	5409	183	51	-169	57	893	1676	157	-119	-35	23	14	72	76	48	236	23
200A	550000	14	52	-41	5409	195	49	-151	40	1000	1866	142	-133	-31	19	25	75	66	35	221	13
200A	550000	21	51	-37	5409	195	48	-157	38	1058	1964	137	-129	-26	17	30	74	70	35	219	15
200A	550000	18	50	-37	5409	195	48	-157	38	1062	1979	133	-129	-29	14	30	72	70	34	219	15
200B	550000	19	50	-40	5409	197	48	-163	37	1086	2022	130	-138	-32	17	27	71	69	33	220	15
201	400000	19	48	-36	5409	190	46	-133	28	1074	1914	118	-116	-26	23	25	76	81	35	221	15
202	300000	20	51	-20	5409	184	50	-75	20	934	1683	104	-70	-14	47	26	88	96	30	226	16
202A	200000	11	47	-20	5409	190	44	-76	17	925	1695	90	-73	-16	42	30	88	94	35	226	18
203	100000	12	52	-25	5409	193	47	-99	22	945	1774	104	-86	-22	35	25	93	86	34	226	17
204	400000	14	50	-24	5409	196	44	-129	30	1013	1898	113	-108	-26	27	31	82	75	34	226	20

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 21	CHAN 22	CHAN 23	CHAN 24	CHAN 25	CHAN 26	CHAN 27	CHAN 28	CHAN 29	CHAN 30	CHAN 31	CHAN 32	CHAN 33	CHAN 34	CHAN 35	CHAN 36	CHAN 37	CHAN 38	CHAN 39	CHAN 40
205	400000	13	49	-26	5409	199	44	-153	37	1086	2029	117	-128	-27	17	33	76	71	35	223	19
206	520000	13	50	-29	5409	200	44	-163	37	1113	2072	115	-135	-31	10	31	75	66	35	223	19
207	450000	14	49	-37	5409	200	43	-167	37	1147	2136	118	-147	-32	10	32	72	67	35	223	18
208	570000	13	50	-41	5409	204	44	-184	37	1205	2219	118	-159	-36	3	31	70	66	35	221	20
208	570000	14	46	-31	5409	192	44	-177	38	1264	2239	50	-121	-35	1	30	69	66	38	223	20
208	570000	14	47	-32	5409	190	45	-176	40	1273	2249	48	-118	-33	0	32	69	70	43	223	20
209	370000	15	45	-25	5409	187	47	-126	27	1194	2058	39	-83	-25	14	27	76	83	40	226	19
209	370000	13	42	-29	5409	185	43	-124	24	1188	2056	38	-83	-26	14	26	75	83	39	226	17
210	520000	14	44	-31	5409	186	44	-157	33	1231	1176	42	-101	-26	4	30	69	75	42	226	18
211	550000	14	44	-33	5409	187	44	-171	35	1261	2227	40	-105	-31	0	30	66	69	41	223	18
212	570000	14	45	-33	5409	186	48	-177	37	1291	2269	39	-108	-31	-2	31	67	66	40	223	14
213	600000	11	45	-33	5409	187	52	-192	35	1408	2337	60	-113	-34	-17	30	61	69	51	221	19
213	600000	13	48	-33	5409	184	56	-195	35	1445	2355	70	-119	-34	-13	29	60	69	53	221	20
213	600000	14	48	-35	5409	184	54	-196	33	1448	2354	70	-119	-35	-13	29	59	69	55	222	20
213	600000	11	48	-35	5409	190	59	-197	30	1463	2358	75	-121	-33	-15	28	61	70	55	221	20
214	620000	13	42	-35	5409	184	64	-207	28	1607	2448	83	-135	-44	-16	23	74	69	81	212	20
214	620000	12	45	-35	5409	180	64	-211	27	1624	2453	83	-138	-44	-15	22	75	71	115	210	20
215	650000	12	45	-45	5409	184	72	-232	25	1737	2567	86	-164	-43	-10	-18	88	61	783	286	-3
215	650000	13	47	-46	5409	184	72	-236	23	1748	2579	88	-168	-43	-10	-17	90	60	818	285	-4
215A	670000	14	47	-50	5409	182	82	-256	29	1867	2699	80	-181	-31	1	-15	85	51	1150	275	-10
216	670000	14	44	-47	5407	180	82	-260	26	1887	2716	77	-184	-31	2	-10	80	50	1188	276	-8
216	670000	13	47	-50	5409	180	84	-264	27	1908	2733	78	-190	-31	0	-13	78	52	1220	276	-7
217	700000	15	50	-54	5309	185	90	-293	26	2037	2863	80	-221	-21	-1	-11	71	49	1359	284	-10
217	700000	15	48	-52	5409	180	91	-302	33	2076	2894	76	-228	17	-5	-17	70	46	1488	279	-15
218	720000	14	43	-48	5409	170	94	-351	28	2227	3034	52	-244	687	-3	-9	62	29	1726	253	-25
219	730000	14	41	-49	5409	173	99	-382	34	2264	3147	40	-273	979	-3	-7	52	22	1860	234	-31
219	750000	14	40	-50	5409	166	104	-403	37	2261	3199	30	-284	1113	0	-7	50	23	1934	227	-26
220	770000	14	32	-14	5409	164	107	-437	37	2224	3013	3	-316	1284	6	23	22	36	2111	172	-30
220	770000	9	38	-10	5409	160	104	-462	29	2207	3032	-28	-338	1297	7	36	6	51	2166	150	-37
221	460000	16	22	1	5409	164	92	-328	-26	1770	2454	-37	-269	1347	40	34	32	97	1914	171	-8
222	600000	16	26	3	5409	168	102	-395	0	2006	2792	-43	-311	1336	28	44	16	81	2084	168	-16
223	750000	16	24	15	5409	169	103	-483	5	2187	3084	-77	-364	1409	20	50	-2	69	2234	139	-25
224	770000	15	26	19	5409	157	99	-535	0	2212	3128	-123	-396	1436	25	43	-8	67	2295	133	-26
225	800000	21	41	37	5409	158	102	-602	-1	2257	3216	-212	-440	1437	35	42	-18	71	2435	96	-28
226	820000	18	62	173	5409	103	9299	-879	27	2285	3303	-321	-501	1465	42	43	-34	81	2542	49	-20
226	820000	15	90	256	5409	152	104	-1083	36	2227	3241	-384	-563	1492	48	47	-38	3288	2603	18	-10
226	820000	15	82	275	5409	146	104	-1123	23	2208	3225	-396	-575	1492	50	50	-40	91	2620	6	-9
226	820000	15	89	267	5409	146	106	-1158	25	2222	3263	-364	-591	1506	50	51	-43	92	2633	0	-5
227	850000	12	81	335	5409	153	132	-1382	-108	2235	3536	-623	-749	1540	59	50	-48	94	2649	-51	14
227	850000	15	36	232	5409	24	1	-923	-44	2111	8089	-653	-442	1566	66	74	-33	89	2600	-75	28
227	850000	14	40	198	5409	10	-6	-822	-23	2066	8089	-702	-392	1559	79	68	-23	88	2534	-77	28
227	850000	16	47	168	5409	20	-28	-760	-35	2006	8089	-672	-351	1541	90	72	-15	87	2483	-76	27
228	550000	10	52	209	5409	29	-26	-697	-47	1960	8089	-629	-321	1573	105	92	3	80	2433	-70	20
228	550000	9	75	301	5409	54	-31	-743	-22	1938	8089	-605	-281	1569	113	88	15	81	2424	-64	20
229	540000	11	90	325	5409	57	-26	-755	-19	1955	8089	-591	-264	1562	114	90	21	85	2425	-62	15
229A	540000	13	92	325	5409	67	-24	-752	-14	1958	8089	-589	-262	1562	115	89	21	86	2423	-57	18
230	600000	14	111	930	5409	43	-6	-1086	87	1956	8089	-538	-171	1589	104	116	16	76	2511	-72	3
231	560000	20	109	1450	5409	44	91	-1245	126	1946	8089	-474	-128	1677	90	218	20	36	2568	-91	-1
232	710000	16	112	2282	5409	34	126	-1537	138	2018	8089	-490	-119	1717	79	531	-2	-156	2551	-94	-10
233	608282	17	116	2107	5409	34	136	-1656	120	1957	8089	-509	-120	1808	76	1280	-117	-473	2503	-111	13
234	608585	16	119	2075	5409	27	132	-1675	120	1975	8089	-514	-121	1906	89	1681	-297	-540	2490	-120	40
235	608787	15	118	2051	5409	20	118	-1705	118	2016	8089	-525	-128	1903	87	2218	-507	-594	2588	-154	100
236	609030	13	117	2014	5409	9	113	-1727	115	2054	8089	-532	-131	1909	94	5145	-581	-568	2446	-138	173
237	609237	11	112	1985	5409	-6	99	-1753	100	2061	8089	-525	-134	1947	109	6423	-794	-615	2263	-151	305
238	609536	16	111	1930	5409	-15	92	-1775	84	2065	8089	7970	-123	1956	123	6423	-1155	-723	2260	-247	589
239	609696	11	112	1914	5409	-12	89	-1783	84	2074	8089	7970	-123	1953	136	6423	-1322	-766	2317	-304	697
239	609696	8	111	1899	5409	-10	88	-1795	83	2072	8089	7970	-125	1953	137	6423	-1435	-794	2342	-345	763
239	0	12	108	1900	5409	-10	91	-1802	82	2076	8089	7970	-128	1949	137	6423	-1538	-814	2385	-384	835
239	0	12	107	1910	5409	-5	93	-1800	82	2075	8089	7970	-127	1949	138	6423	-1613	-825	2421	-414	
239	0	11	110	1914	5409	-7	94	-1802	80	2070	8089	7970	-125	1951	140	6423	-1685	-843	2435	-434	
239	0	2	102	1910	5409	-10	86	-1810	75	2061	8089	7970	-133	1946	130	6423	-1737	-854	2484	-458	

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
1	70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A	70707	2	0	1	1	1	0	1	0	1	3	-2	-2	0	1	-1	0	-1	1	0	0
2	101010	0	2	1	3	1	-4	0	-2	3	3	6	6	5	11	-3	-2	7	10	6	0
2A	101010	1	2	4	4	-3	-4	-4	2	2	0	7	4	7	6	-3	-5	0	3	2	-1
3	121212	2	0	0	4	0	-5	0	1	0	0	10	9	12	15	-8	-8	5	7	3	-6
3A	121212	2	-1	3	4	2	-6	-2	-2	2	0	10	11	13	16	-7	-7	6	9	7	-3
4	151515	2	4	3	3	6	-7	2	0	4	0	19	18	19	21	-10	-9	10	12	8	-3
4A	151515	1	1	1	3	5	-5	0	2	4	0	19	18	19	20	-12	-9	7	12	7	-5
5	171717	4	1	-1	3	5	-10	-1	-2	3	-2	27	23	27	30	-17	-17	13	15	12	-9
5A	171717	2	-2	0	2	6	-14	0	0	3	-1	28	25	27	29	-17	-19	10	17	10	-10
6	202020	0	-2	-1	4	12	-12	6	-2	8	-2	40	40	37	41	-19	-18	20	25	20	-10
6A	202020	2	1	-3	2	12	-12	5	-2	4	-4	40	39	39	41	-17	-20	19	27	24	-10
7	222222	2	-2	-3	2	13	-16	4	-2	3	-6	50	46	49	49	-22	-27	22	31	26	-16
7A	222222	2	-2	-3	2	11	-15	3	-1	3	-5	50	50	45	50	-27	-28	25	32	28	-14
7B	222222	2	0	0	3	4	15	-11	3	4	6	-3	54	50	50	52	-21	-27	25	31	25	-12
8	202020	2	-2	0	3	8	-0	1	2	4	-1	47	45	45	45	-21	-20	21	30	27	-12
8A	202020	1	-1	-1	3	12	-11	4	3	4	-3	48	48	46	46	-19	-21	22	29	27	-13
9	151515	0	-3	-1	4	6	-6	2	6	5	0	37	32	33	33	-11	-14	16	21	20	-7
9A	151515	0	-2	-1	3	5	-4	4	5	6	-2	37	34	33	33	-9	-14	15	22	19	-7
10	70707	1	-2	1	2	-1	4	2	8	4	4	15	17	15	13	2	1	6	11	10	0
10A	70707	1	-2	0	2	-2	3	-1	6	3	3	15	14	13	13	1	0	3	7	8	0
11	70707	16	19	33	59	34	26	37	36	36	19	60	60	53	66	27	33	55	61	55	23
11A	70707	14	22	31	61	33	24	37	37	34	23	56	61	52	61	28	35	52	59	53	30
12	101010	16	20	30	61	33	23	36	34	35	20	64	66	57	68	27	32	57	62	56	26
12A	101010	16	20	32	62	35	25	36	37	34	20	65	61	55	68	24	33	55	61	55	28
13	121212	16	20	30	62	36	20	36	35	34	20	68	67	60	73	22	26	57	64	59	20
13A	121212	13	22	31	61	38	21	34	36	34	20	68	67	59	71	22	24	53	62	55	23
14	151515	14	20	31	63	35	19	36	34	33	18	71	74	64	77	18	21	58	62	55	17
14A	151515	14	22	28	62	33	18	35	33	34	20	71	71	65	75	13	20	55	61	56	19
15	171717	16	22	30	61	41	15	35	35	33	17	77	77	79	67	11	17	57	66	59	16
15A	171717	16	22	30	64	38	16	34	37	31	20	79	80	66	77	13	18	57	62	57	17
16	202020	17	23	28	62	40	12	33	33	32	16	83	86	73	86	8	12	57	68	58	13
16A	202020	16	22	25	64	42	13	34	35	31	17	83	83	70	85	3	12	57	65	56	11
17	222222	16	22	26	61	41	10	32	32	31	14	87	89	75	90	3	5	59	69	60	9
17A	222222	17	22	26	61	41	10	30	34	32	16	89	89	75	89	3	6	59	67	59	9
18	202020	16	21	26	62	41	13	29	33	29	17	80	85	68	81	8	9	54	64	56	11
18	202020	16	22	27	63	37	12	31	33	30	15	80	84	70	81	8	10	55	62	57	10
19	171717	14	23	27	62	36	14	30	33	33	19	70	74	60	73	9	11	50	57	48	10
19A	171717	16	22	28	62	37	13	32	35	29	18	71	71	60	71	6	10	48	55	48	9
20	121212	16	20	28	62	33	23	30	35	32	20	58	59	46	56	13	20	40	49	40	16
20A	121212	17	22	27	62	33	23	27	37	30	23	53	57	45	56	13	17	38	48	65	15
21	70707	16	24	28	64	26	30	24	38	26	27	36	39	32	39	26	33	33	42	36	23
21	70707	15	24	31	64	26	29	24	38	27	27	30	40	30	39	23	33	37	42	36	27
21A	70707	13	23	29	63	24	27	22	38	22	27	25	31	25	36	22	32	29	37	26	20
21B	70707	13	24	28	63	25	26	20	40	24	27	25	29	25	31	23	31	24	32	27	18
22	100710	16	23	30	64	24	26	17	35	22	25	18	21	17	21	23	33	33	40	29	16
22A	100710	14	24	29	64	18	27	17	37	21	23	16	20	15	21	23	33	33	36	27	17
23	120712	15	25	26	64	21	28	19	35	24	26	13	19	10	19	27	33	37	43	34	14
23A	120712	15	24	25	64	21	26	18	37	22	20	12	19	16	19	23	32	33	42	30	10
24	150715	14	25	27	69	19	28	17	37	24	26	16	21	9	15	23	33	41	49	40	10
24A	150715	16	24	24	69	16	26	15	34	22	19	8	14	9	5	23	33	41	47	37	10
30	170717	16	24	23	69	18	27	13	32	24	16	0	10	3	10	28	36	47	52	40	8
30	170717	17	25	23	71	14	25	18	30	23	17	3	10	5	11	28	36	45	52	43	5
31	200720	18	26	24	72	10	29	19	31	24	14	-1	7	5	6	29	40	55	62	50	2
31	200720	17	25	24	73	20	26	16	31	24	13	-1	4	-1	6	30	38	53	59	49	0
32	220722	16	28	24	74	19	28	17	30	19	14	-5	0	-3	1	31	39	60	66	57	0
32	220722	19	26	24	74	18	29	17	30	22	12	-5	-1	-2	1	30	39	59	64	55	-2
33	200726	17	28	25	74	17	26	15	31	21	14	-1	4	-1	5	28	38	52	59	48	3
33	200730	16	28	24	72	17	26	16	31	24	14	-3	4	-1	6	28	37	50	55	46	0
34	170717	16	25	24	72	16	26	15	32	22	17	-2	5	3	4	26	33	44	52	40	3
34	170717	16	25	24	72	17	28	15	34	22	16	-1	4	0	6	27	37	45	51	39	6

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
35	150715	16	27	23	71	18	27	15	35	20	18	0	8	-1	8	23	33	38	42	33	5
35	150715	16	25	25	72	18	27	16	37	21	20	2	10	4	10	23	33	39	45	34	7
36	120712	17	25	25	70	15	24	16	38	23	24	4	11	6	11	23	33	34	37	28	9
36	120712	17	25	23	72	21	26	19	38	22	25	4	13	5	11	23	33	35	38	27	9
37	100710	17	23	24	69	16	29	16	36	19	24	8	17	10	16	22	30	27	29	20	13
37	100710	19	21	27	71	18	26	14	40	17	25	10	15	12	16	21	31	25	30	18	11
38	70707	17	23	29	202	26	25	24	45	22	32	23	29	19	28	21	30	27	34	25	17
38	70707	19	23	28	203	24	25	22	42	24	33	25	29	17	28	20	28	23	35	25	19
51	70707	-11	10	21	91	25	19	30	45	19	25	40	47	30	47	12	29	30	29	17	13
51	70707	-13	11	26	83	26	22	30	47	21	25	38	48	30	46	17	28	30	29	15	13
52	71007	-12	12	24	84	27	20	29	48	23	27	42	56	37	54	11	28	30	27	15	12
52	71007	-12	11	24	84	28	21	27	48	20	26	38	56	36	54	10	23	29	23	10	15
53	71207	-11	13	25	87	30	16	25	48	17	29	46	64	44	61	8	21	23	20	8	17
53	71207	-13	13	21	88	29	16	25	53	16	28	48	62	43	60	3	20	21	19	9	16
54	71507	-16	13	24	88	28	13	17	52	14	30	50	71	50	69	1	15	18	12	0	19
54	71507	-14	11	25	84	28	14	20	51	15	30	52	70	53	66	1	13	18	14	0	18
55	71707	-13	12	24	88	28	12	20	53	12	32	60	78	59	74	-5	9	13	11	-2	18
55	71707	-16	11	21	84	27	11	17	52	11	33	59	75	59	73	-5	8	9	9	-2	18
56	72007	-13	10	21	84	26	7	16	56	11	37	67	84	65	81	-9	3	9	5	-3	24
56	72007	-13	13	20	84	28	9	16	55	12	35	67	85	66	81	-10	5	8	3	-6	24
57	72207	-14	13	20	87	28	3	14	55	9	39	77	95	69	91	-18	-3	2	0	-10	20
57	72207	-13	11	21	84	28	4	15	57	9	40	88	94	70	86	-17	-3	4	-1	-13	25
58	72007	-15	12	21	88	26	7	14	54	8	37	69	84	60	79	-11	2	4	-1	-11	23
58	72007	-15	12	20	89	27	8	12	55	10	38	65	81	60	77	-13	3	3	1	-10	20
59	71707	-16	12	19	87	25	13	14	56	9	35	55	69	50	68	-5	5	5	2	-10	20
59	71707	-17	11	18	89	26	11	14	54	6	33	55	70	49	66	-7	6	3	0	-8	20
60	71507	-16	12	18	92	21	14	14	55	9	33	44	60	38	54	-3	11	5	2	-6	17
60	71507	-17	14	19	89	25	13	14	55	9	36	44	60	38	56	0	12	7	2	-7	18
61	71207	-16	12	20	89	18	16	14	58	7	36	39	55	35	50	0	17	-5	-10	-15	25
61	71207	-20	14	20	94	21	16	14	53	10	35	32	49	27	44	1	21	9	3	-3	17
63	70707	-15	15	19	95	15	25	16	52	11	30	12	28	9	24	14	30	15	10	0	16
63	70707	-15	15	17	93	17	25	13	53	12	29	12	31	9	21	16	29	10	7	-3	17
1A	70707	-13	18	15	94	11	22	7	53	9	31	8	20	3	19	15	31	10	9	-4	15
2A	101010	-13	19	14	97	13	19	7	51	7	30	13	26	7	24	12	29	13	11	-2	12
3A	121212	-13	19	14	100	14	16	6	51	8	30	18	33	15	29	10	26	18	15	2	11
4A	151515	-13	17	14	98	15	15	5	52	4	30	24	39	19	37	3	21	20	18	5	9
5A	171717	-12	19	12	98	17	13	6	51	7	28	30	45	26	40	3	16	23	19	9	7
6A	202020	-14	18	12	100	18	9	6	47	6	24	37	48	30	49	-1	13	24	24	10	2
7A	222222	-13	19	10	99	21	7	5	50	9	25	43	54	34	55	-7	6	28	29	10	0
8A	202020	-16	18	11	99	18	8	7	50	6	27	37	48	29	46	-2	11	26	21	9	0
9A	171717	-13	21	13	99	14	4	5	52	4	31	28	41	23	41	2	16	20	18	5	4
10A	151515	-13	16	13	94	13	15	4	51	3	31	20	34	16	33	3	20	16	11	-3	4
11A	121212	-13	18	14	98	8	19	-3	52	1	33	10	27	9	25	9	23	10	10	-5	8
12A	101010	-13	15	11	97	6	16	3	49	2	34	4	20	3	18	12	28	8	4	-11	8
13A	70707	-12	15	11	96	5	20	4	56	3	34	0	13	-1	13	13	33	8	1	-14	7
76	70707	2	17	16	72	13	28	15	67	9	33	37	47	30	41	23	45	27	25	15	18
77	121212	2	20	16	79	13	23	17	68	14	34	42	57	39	56	20	39	35	36	26	16
77A	121515	7	22	17	79	13	23	15	71	14	30	36	61	40	59	3	33	37	37	23	13
78	171717	7	24	17	78	24	22	14	68	14	30	37	65	45	59	10	31	36	32	20	14
78A	202020	4	23	16	81	25	16	12	67	11	30	44	68	46	60	3	24	37	37	24	10
79	222222	5	23	16	82	27	16	15	68	14	28	55	75	55	69	3	20	39	40	28	8
80	252525	3	23	11	90	28	11	16	71	14	30	58	83	58	75	0	18	43	42	32	5
80A	252525	6	23	11	81	26	11	11	72	17	30	60	81	59	74	-1	18	43	42	30	4
81	272727	5	23	12	82	26	8	10	68	8	28	66	84	62	79	-7	12	43	41	32	5
81A	272727	5	24	11	81	28	9	7	68	11	27	66	84	62	79	-7	11	46	41	30	1
82	303030	6	25	14	84	31	9	9	69	9	29	73	90	69	89	-9	10	46	47	35	0
82A	303030	5	24	14	83	29	6	7	71	11	28	77	88	68	87	-10	7	45	45	34	0
83	323232	3	24	11	84	30	6	7	71	10	26	83	97	75	95	-17	3	50	48	37	0
83A	323232	6	25	13	84	34	5	7	71	12	27	84	99	75	97	-17	3	48	49	35	0
84	353535	8	26	15	88	30	3	14	75	17	28	96	108	84	107	-20	1	54	52	45	-3
84A	353535	7	28	15	84	35	3	10	72	12	28	95	107	87	106	-19	-2	53	55	44	-2

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
84B 353535	6	28	14	86	36	2	7	69	14	28	98	108	87	106	-20	-1	50	53	45	-4
84C 353535	6	28	14	86	36	4	11	73	13	28	97	108	88	106	-20	-1	53	54	40	-3
85 373737	9	25	14	84	37	1	13	72	13	27	107	115	97	114	-24	-7	55	58	45	-4
85A 373737	8	25	12	98	36	1	12	73	14	25	110	121	99	117	-26	-7	56	57	47	-3
86 353535	6	28	14	94	35	3	10	74	12	26	104	109	90	110	-21	-1	54	58	43	-3
87 323232	3	25	14	84	34	4	7	73	13	27	97	101	83	101	-17	5	49	50	37	0
88 303030	8	25	16	86	31	7	10	73	11	28	90	94	77	94	-14	5	45	47	35	2
89 272727	7	25	17	88	28	13	10	75	12	31	83	91	75	89	-9	13	44	43	30	5
90 252525	6	25	15	84	27	14	7	76	11	33	73	79	65	81	-7	16	36	40	29	7
91 222222	3	25	14	96	23	20	6	76	9	33	69	73	57	73	-2	20	34	37	25	8
91A 202020	9	27	17	87	20	22	6	77	10	36	62	66	53	65	1	26	33	36	23	12
92 171717	7	27	18	88	17	25	7	81	11	38	55	62	40	60	7	31	26	27	17	13
92A 151515	6	25	17	92	14	29	7	80	9	40	48	51	39	51	11	36	25	25	17	17
93 121212	6	24	16	90	13	30	7	80	3	40	38	45	32	41	17	40	20	20	11	19
94 70707	3	28	16	88	5	36	2	84	4	44	22	30	18	26	22	51	10	12	7	27
95 70707	4	32	18	63	18	36	20	92	11	40	39	62	45	60	28	57	31	27	15	23
95A 121212	1	20	18	72	22	31	18	89	12	36	52	78	53	71	20	49	37	31	17	20
96 171717	5	23	18	74	26	24	15	90	14	34	65	88	64	81	12	43	41	37	19	16
96A 222222	5	24	14	73	29	20	17	88	14	36	80	99	74	95	6	33	53	47	30	11
97 272727	1	24	13	74	32	15	19	86	14	30	95	114	89	108	-2	22	58	52	37	8
97A 323232	2	24	11	74	34	8	17	83	12	27	106	123	99	119	-12	14	60	60	40	0
97B 353535	2	25	12	74	38	6	15	84	13	30	113	128	105	128	-17	10	65	60	40	0
98 373737	4	25	13	78	41	4	16	85	12	28	120	135	110	133	-19	6	66	62	48	-1
99 373232	2	25	14	78	39	10	15	88	12	30	108	121	96	113	-13	13	58	54	38	-1
100 372727	4	27	15	77	28	18	14	91	10	33	94	105	84	103	-4	22	48	44	29	5
100A 372727	3	26	14	77	27	16	12	92	9	34	94	104	81	101	-7	21	48	42	30	7
100B 372727	3	28	12	80	23	16	4	92	4	35	88	99	77	96	-3	22	43	34	20	5
100C 372727	4	25	11	81	23	16	4	92	4	36	86	94	73	93	-3	21	38	34	21	6
101 372222	4	25	10	79	17	26	5	98	3	40	73	81	63	78	3	30	33	22	11	10
101A 372222	4	25	10	77	17	23	6	97	2	40	75	84	63	78	3	28	33	24	10	9
102 371717	2	24	12	80	12	31	4	101	3	42	59	69	48	65	12	41	25	21	8	15
102A 371717	3	24	12	81	11	32	5	98	1	40	59	67	48	61	9	38	25	19	6	15
102B 371515	6	25	15	82	8	35	1	101	-1	46	50	61	43	54	17	45	20	11	0	17
102C 371515	4	24	14	82	7	35	3	102	2	47	49	59	40	54	17	46	22	12	1	20
103 371212	6	25	15	81	6	40	1	104	-1	49	44	51	34	47	21	51	18	7	-6	20
103A 371212	6	27	15	82	7	39	-1	107	-1	48	41	51	34	44	23	50	14	7	-5	20
103B 371010	5	27	16	80	3	43	0	107	-2	50	33	45	26	38	24	53	9	2	-10	23
103C 371010	5	27	16	83	2	42	0	106	-2	50	33	43	25	34	26	53	10	1	-11	23
104 370707	3	25	15	83	-1	44	-2	108	-3	53	25	34	17	29	28	60	7	-3	-11	28
104A 370707	3	27	16	83	1	44	0	108	-1	52	25	34	17	29	25	61	5	-3	-13	25
105 370707	5	27	16	84	-2	44	0	108	0	54	25	31	16	27	29	59	5	-3	-13	27
106 270707	4	27	15	84	-2	45	0	107	0	50	23	31	16	26	30	59	5	-6	-13	24
107 220707	4	29	16	84	3	45	2	106	1	53	25	34	19	26	31	60	8	-4	-11	27
108 150707	4	31	16	84	4	41	0	105	-1	51	24	33	19	29	30	60	7	-3	-13	24
109 70707	5	30	16	88	4	41	-3	105	0	53	23	35	17	24	29	61	9	-3	-13	25
114A 70707	-4	38	23	182	21	56	21	142	14	59	65	69	50	67	51	94	47	41	29	33
115 120712	-5	42	22	196	19	56	20	138	17	55	66	66	45	59	56	96	57	52	40	28
116 170717	-7	45	13	190	18	58	17	135	14	48	39	53	35	47	58	99	68	61	49	19
117 220722	-7	47	16	193	17	56	19	131	14	40	27	45	25	39	63	103	79	72	59	14
118 250725	-7	46	16	193	15	56	15	129	13	40	23	38	18	31	60	105	86	79	67	7
119 270727	-7	47	17	196	12	58	15	127	17	36	18	34	15	25	66	106	90	85	70	7
120 300730	-7	48	10	196	11	56	14	127	21	37	13	27	7	20	66	107	98	92	76	0
121 320742	-6	49	12	198	8	56	17	125	21	30	7	24	3	13	68	111	103	97	85	-2
122 330735	-5	51	12	203	13	56	20	125	23	29	2	19	-3	10	71	111	106	102	90	-5
123 370737	-7	54	10	203	12	60	19	123	22	26	-3	14	-7	0	71	113	114	110	99	-12
123A 400740	-7	55	9	204	6	56	15	122	20	24	-10	4	-15	-5	71	112	115	111	100	-15
123B 370737	-8	54	10	204	8	61	17	123	21	30	-10	4	-15	-6	71	113	110	106	97	-12
123C 370737	-7	58	6	208	2	56	7	125	17	29	-22	-10	-27	-19	71	113	104	99	89	-13
124 350735	-5	58	10	211	3	61	7	130	19	34	-22	-10	-23	-20	75	113	99	92	84	-10
125 320732	-3	59	10	210	1	62	5	131	14	38	-19	-9	-21	-16	71	112	87	84	75	-5
126 300730	-3	55	10	210	-1	61	5	131	14	43	-17	-9	-21	-16	69	112	79	77	67	-3

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
127 270727	-5	57	12	209	1	61	-1	136	11	44	-14	-7	-21	-14	68	110	69	65	57	4
128 250725	-6	55	11	207	-4	59	-2	135	11	48	-17	-5	-21	-11	63	106	64	60	49	6
129 220722	-5	55	11	207	-4	56	-5	138	7	50	-13	-5	-20	-12	66	105	54	47	42	9
130 170717	-4	55	11	204	-4	62	-7	145	2	58	-10	2	-15	-4	62	102	40	36	29	15
131 120712	-3	53	12	208	-5	57	-8	148	2	65	-3	8	-7	0	60	100	28	22	14	23
132 70707	-5	51	11	212	-8	58	-13	149	1	70	0	11	0	6	56	93	10	9	-4	28
133 70707	-5	40	10	204	-12	48	-16	150	-16	67	18	30	7	21	53	96	10	6	-5	35
134 71207	-6	38	9	203	-14	43	-16	151	-19	73	36	47	27	40	43	83	4	-1	-12	36
135 71707	-5	33	7	202	-12	36	-20	155	-22	75	56	69	47	59	31	73	-4	-10	-20	40
136 72207	-5	35	11	199	-6	31	-23	158	-23	78	74	88	63	80	20	63	-10	-12	-28	42
137 72507	-4	34	7	193	-8	26	-25	158	-24	79	87	98	75	89	16	58	-17	-19	-29	40
137A 202520	-5	38	6	191	-4	29	-23	150	-19	68	70	81	59	76	22	63	14	10	0	28
138 202720	-3	39	5	191	-1	26	-19	153	-16	68	80	90	67	86	17	62	10	12	-1	27
139 203020	-3	40	7	192	-2	26	-23	154	-19	70	90	98	77	91	17	55	7	6	-1	29
140 203220	-5	36	4	164	4	22	-17	156	-19	72	102	114	88	108	8	48	6	7	-3	30
141 203520	-3	40	6	264	7	20	-16	158	-18	75	118	125	102	120	2	42	-2	-1	-6	34
142 203720	-4	36	8	284	7	16	-18	161	-16	79	412	138	108	131	-4	36	-3	0	-11	33
142A 173717	-5	34	4	279	2	14	-26	156	-27	75	421	136	100	126	-7	33	-10	-8	-21	26
142B 153715	-4	35	4	190	3	15	-24	163	-23	80	430	139	103	130	-8	36	-16	-16	-30	34
142C 153715	-4	32	7	190	4	16	-25	163	-26	82	441	146	108	133	-8	33	-23	-21	-38	38
143 153515	-6	36	6	198	8	16	-23	163	-25	82	431	136	99	124	-2	38	-21	-19	-32	39
144 153215	-5	35	4	204	-2	20	-24	163	-21	80	419	126	89	114	1	43	-17	-15	-32	37
145 153015	-2	39	5	208	-2	24	-24	161	-27	80	410	115	80	101	8	48	-12	-13	-30	35
146 152715	-5	37	1	207	-6	26	-25	162	-26	79	397	104	69	93	13	53	-11	-13	-30	32
147 152515	-1	38	1	211	-12	31	-24	158	-24	77	384	91	58	81	16	60	-10	-12	-27	31
147A 72507	-3	37	4	207	-12	30	-27	167	-27	87	401	109	73	94	11	53	-30	-31	-48	40
148 72207	-3	40	3	207	-12	34	-27	164	-28	87	395	96	60	79	9	63	-29	-31	-45	40
149 71707	-2	37	4	209	-16	39	-26	164	-26	83	360	74	40	58	28	76	-25	-25	-43	40
150 71207	-1	44	4	212	-22	45	-27	164	-28	83	329	51	20	33	41	91	-18	-21	-35	37
151 70707	0	43	3	214	-26	53	-27	159	-23	79	296	30	0	11	51	101	-12	-13	-31	36
152 70707	0	51	-5	160	-30	65	-33	178	-26	86	289	21	-1	4	59	110	-16	-20	-25	46
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153 120000	0	50	-3	162	-19	54	-26	181	-24	80	328	54	28	34	43	98	0	-5	-6	34
153A 220000	0	51	-9	164	-13	51	-25	177	-25	79	347	68	42	49	37	91	6	6	-1	34
154 270000	0	52	-9	164	-11	44	-23	177	-19	77	367	83	55	64	30	82	14	10	7	29
154A 300000	-2	47	-13	163	-6	36	-16	175	-16	70	385	97	65	77	26	72	25	20	17	27
154B 320000	0	48	-14	164	-4	36	-20	177	-18	72	394	101	70	81	22	69	24	23	17	26
154C 350000	0	50	-12	163	-1	34	-19	173	-16	68	410	109	83	97	21	69	29	32	24	20
155 370000	0	48	-13	163	3	31	-17	171	-15	65	429	120	91	107	14	63	32	39	28	19
156 400000	0	49	-11	163	7	27	-13	170	-9	56	456	137	105	119	13	62	40	44	35	17
156A 400000	0	47	-14	160	9	27	-13	169	-9	55	485	148	112	130	8	61	45	50	40	13
157 420000	0	47	-14	163	8	26	-11	168	-11	54	506	160	123	139	8	53	50	57	47	15
158 450000	1	58	-19	186	20	16	12	156	4	40	858	570	539	373	10	90	55	62	58	13
158 450000	0	58	-19	186	21	18	14	155	4	37	865	584	578	393	9	89	53	61	58	12
158 450000	-1	56	-21	204	22	16	14	157	4	38	865	588	595	399	11	88	54	59	55	10
159 420000	1	58	-19	208	19	23	14	158	3	40	856	581	589	398	16	93	51	59	55	14
160 400000	2	59	-21	204	17	26	12	158	2	43	850	575	582	390	21	98	49	52	53	17
161 370000	0	59	-24	207	15	29	7	162	-1	48	837	566	573	381	23	99	43	47	47	17
161A 370000	0	59	-22	210	13	28	7	165	-4	47	838	567	581	384	23	101	45	48	46	20
161B 370000	0	59	-20	213	20	33	266	167	4	45	849	580	581	399	26	106	54	56	56	20
161C 370000	-5	62	-16	233	27	38	21	173	10	44	865	598	607	418	32	110	66	76	74	24
161D 370000	-3	59	-13	197	25	41	15	177	9	43	850	587	598	407	36	113	60	70	71	24
161E 370000	-3	67	-14	199	22	41	16	177	11	43	847	582	594	407	33	112	60	70	70	24
162 350000	0	72	-13	200	27	45	16	182	10	48	840	576	587	401	41	121	60	67	70	27
163 320000	-4	65	-16	193	19	49	15	179	8	48	825	568	572	389	41	121	53	62	66	28
164 270000	-4	68	-14	196	12	55	15	186	4	57	794	552	556	376	50	132	47	56	57	34
165 220000	-1	65	-14	196	13	62	12	187	0	58	759	536	532	357	57	140	39	47	50	38
166 170000	-2	65	-13	195	6	69	7	193	-3	65	716	516	505	331	66	150	30	40	43	44
167 120000	-1	70	-15	184	1	75	3	196	-9	73	670	491	477	316	77	162	28	34	37	51
168 70000	-1	68	-16	134	-2	84	-1	198	-11	79	626	471	448	296	82	171	20	27	30	57
169 120000	1	71	-14	188	3	75	0	196	-8	73	644	488	467	314	80	163	27	35	39	52

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
169A	120000	0	70	-12	196	3	75	-7	197	-10	75	637	486	469	314	77	162	30	32	38	54
170	170000	0	72	-14	188	8	69	-4	193	-7	69	662	505	489	331	71	153	36	42	46	47
171	220000	1	68	-13	187	13	64	2	193	-4	63	693	522	515	350	61	146	44	50	50	43
171A	220000	4	67	-12	212	20	61	11	195	3	60	716	540	525	365	66	147	56	57	54	38
172	252222	2	70	-10	231	19	64	11	196	3	61	712	536	522	358	67	146	49	52	50	37
172	272222	2	66	-12	231	21	64	13	196	1	63	714	537	519	359	66	145	50	51	52	35
173	302222	0	68	-12	233	18	65	14	197	3	65	700	534	517	357	66	145	49	51	50	39
174	322225	1	65	-12	233	18	66	15	198	1	65	690	533	517	356	68	147	47	48	50	34
175	352222	0	69	-14	234	16	67	13	200	2	68	694	531	514	351	68	145	40	46	44	36
176	372222	4	72	-13	237	17	69	12	198	-1	65	695	530	513	351	69	145	39	43	44	35
177	352232	2	72	-15	233	15	66	11	203	-1	66	699	528	511	350	70	151	40	42	40	39
178	322222	3	70	-12	237	16	70	14	207	1	68	696	529	509	349	71	150	40	42	40	38
179	302222	0	68	-18	234	11	64	7	203	-3	67	690	522	504	341	68	147	37	42	39	36
180	272222	0	70	-17	237	13	66	7	204	-4	67	691	524	505	346	68	147	36	42	36	33
181	252222	2	70	-12	237	15	66	4	198	-6	67	689	519	503	341	68	146	37	39	37	37
182	222222	2	71	-16	234	13	67	5	201	-6	66	689	517	501	340	68	146	33	40	38	39
183	252232	3	74	-17	237	13	66	1	198	-7	67	687	517	499	339	68	147	30	39	36	38
183A	252222	1	72	-14	237	9	65	-3	200	-8	68	681	510	493	331	66	144	26	31	29	34
184	250000	2	72	-21	236	13	61	-3	198	-8	67	688	515	499	339	63	141	28	32	30	30
185	270000	0	68	-22	235	10	56	-3	198	-7	60	700	523	508	346	57	133	30	35	32	27
186	300000	0	68	-24	237	13	54	-3	196	-6	59	715	534	519	356	50	131	30	36	34	25
187	320000	3	65	-24	234	12	50	0	191	-6	56	735	541	529	361	43	122	30	38	35	19
188	350000	0	65	-22	235	7	44	1	189	-2	53	750	551	545	374	42	120	33	38	40	20
189	370000	2	69	-22	239	17	44	-1	185	-6	50	770	560	514	390	41	120	49	57	50	20
189A	370000	5	70	-23	243	10	42	4	185	-1	50	774	571	566	383	41	124	48	52	52	19
189B	370000	6	69	-17	240	37	39	28	185	11	44	840	617	631	450	42	120	84	86	85	18
189C	370000	1	55	-15	334	43	36	32	184	10	44	857	631	645	465	37	120	83	83	77	10
189D	370000	2	54	-14	342	46	35	35	187	18	41	856	631	644	467	36	117	87	87	80	12
189E	370000	1	59	-3	377	44	44	46	195	27	45	870	642	659	479	43	100	102	103	103	10
189E	370000	0	58	-3	374	49	43	49	196	29	44	870	641	659	480	45	127	100	104	106	10
189F	370000	0	61	-2	383	53	45	46	195	32	43	861	636	647	468	43	123	98	102	106	13
189F	370000	0	60	-4	382	51	44	44	197	29	44	859	631	647	465	42	122	99	102	105	12
189G	370000	3	62	0	387	56	45	47	198	34	45	866	640	654	473	43	123	103	106	110	12
189H	370000	0	59	0	243	56	39	47	197	32	45	862	640	653	469	43	122	100	102	103	7
190	400000	0	61	0	242	56	36	50	198	34	44	873	649	665	480	39	121	107	109	105	4
191	420000	-1	55	-2	211	55	33	51	193	36	39	884	659	679	489	33	106	109	109	110	-1
192	450000	-1	54	0	209	58	30	53	191	40	37	898	674	699	501	32	111	108	112	110	-3
193	470000	0	55	0	242	60	26	56	187	42	33	923	698	729	521	29	109	114	118	116	-5
193	470000	-1	56	1	241	61	26	56	186	40	32	924	694	727	521	29	111	110	119	3318	-5
194	500000	0	53	0	239	60	23	58	185	43	30	952	728	759	549	23	109	114	120	118	-12
194	500000	0	720	3	226	61	23	60	182	44	27	955	731	765	549	23	111	117	121	119	-12
195	300000	-1	57	1	231	47	51	45	197	31	48	856	660	672	480	57	140	84	90	90	10
196	400000	0	54	1	229	54	36	55	193	38	39	900	695	717	515	41	122	99	104	106	0
197	450000	0	55	1	228	56	33	52	188	40	35	925	710	738	533	35	116	106	110	113	-5
198	500000	-1	53	0	229	60	22	54	184	44	28	950	736	776	558	28	110	110	119	120	-14
199	520000	0	53	0	229	65	19	60	178	44	25	985	777	814	581	23	110	115	124	127	-14
199	520000	-2	51	6	232	65	20	59	178	46	20	988	824	869	594	29	110	118	126	125	-13
200	550000	0	48	8	226	68	14	61	176	47	20	1017	1051	833	626	29	110	118	129	127	-18
200	550000	0	45	13	224	68	15	65	175	50	20	1026	1103	844	641	30	111	119	132	131	-15
200	550000	-1	45	10	222	66	14	64	175	44	18	1052	1136	842	636	26	110	124	127	128	-18
200A	550000	-2	45	12	222	66	13	64	173	50	18	1048	1141	846	641	29	110	127	128	126	-17
200A	550000	0	45	14	223	65	15	172	171	50	20	1050	1146	853	651	30	111	147	126	120	-18
200A	550000	-1	32	11	214	71	15	987	723	46	37	1053	1141	875	679	31	110	147	144	152	-16
200A	550000	0	28	14	221	86	3	1194	1368	50	40	1050	1141	896	689	50	110	150	152	854	-23
200A	550000	0	27	14	217	84	4	1218	1485	44	42	1049	1140	904	693	49	106	149	150	870	-27
200B	550000	-1	27	14	222	83	3	1249	1582	47	43	1052	1143	907	697	53	109	150	152	885	-29
201	600000	-1	30	16	232	68	20	1179	1667	38	56	985	1048	838	645	73	130	128	129	838	-12
202	200000	-1	35	7	234	54	51	1024	1695	24	74	829	871	709	564	100	163	98	94	736	13
202A	200000	0	31	12	232	58	53	1042	1717	26	72	845	888	719	581	99	168	108	101	747	7
203	300000	0	33	16	235	71	39	1106	1722	34	64	897	944	769	621	85	152	123	119	780	-4
204	400000	4	29	12	232	78	25	1189	1746	39	56	974	1020	829	666	71	132	140	136	831	-15

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 41	CHAN 42	CHAN 43	CHAN 44	CHAN 45	CHAN 46	CHAN 47	CHAN 48	CHAN 49	CHAN 50	CHAN 51	CHAN 52	CHAN 53	CHAN 54	CHAN 55	CHAN 56	CHAN 57	CHAN 58	CHAN 59	CHAN 60
205	500000	2	29	16	234	88	10	1292	1846	46	49	1046	1114	904	728	60	120	161	154	898	-24
206	520000	0	28	16	232	91	6	1327	1897	44	44	1066	1136	929	747	59	117	164	157	917	-29
207	550000	2	30	17	232	92	3	1367	2003	46	44	1089	1163	945	774	58	116	169	161	943	-31
208	570000	3	29	19	242	97	0	1436	2126	52	44	1107	1194	1009	807	60	115	173	145	965	-29
208	570000	4	27	20	242	96	-4	1457	2188	52	44	1114	1199	1018	809	63	117	176	145	969	-26
208	570000	2	27	19	242	99	-4	1467	2246	56	43	1116	1204	1027	811	63	116	177	148	973	-28
209	370000	0	32	18	256	79	25	1337	2282	40	60	1013	1073	921	737	94	147	145	116	889	-7
209	370000	-1	28	14	254	74	22	1334	2293	39	56	1010	1068	917	735	89	143	144	115	888	-10
210	500000	0	28	15	254	86	4	1423	2306	44	44	1070	1147	983	786	74	123	165	134	937	-20
211	550000	-3	25	14	252	88	-4	1463	2328	47	44	1100	1185	1014	809	69	118	170	142	960	-24
212	570000	-1	28	16	258	92	-5	1494	2389	48	40	1116	1195	1039	826	70	115	180	142	976	-30
213	600000	-1	22	23	257	96	-8	1551	2520	101	45	1163	1211	1115	834	96	110	180	140	1040	-35
213	600000	0	24	10	258	70	6	1566	2548	126	44	1158	1205	1113	837	93	110	178	141	1047	-36
213	600000	0	25	7	277	68	8	1567	2555	132	43	1159	1204	1115	836	92	110	179	143	1048	-32
213	600000	-1	25	6	278	67	11	1578	2586	142	43	1166	1206	1117	840	93	112	180	144	1054	-33
214	620000	0	39	-19	341	170	46	1644	2591	466	-16	1176	1235	1116	875	107	136	193	162	1076	-40
214	620000	0	40	-17	340	196	49	1647	2593	484	-20	1188	1219	1119	873	108	137	183	161	1076	-43
215	650000	0	64	-27	299	483	61	1700	2531	632	-35	1232	1250	1196	917	110	143	201	180	1120	-44
215	650000	-2	64	-29	300	515	62	1710	2533	644	-40	1240	1259	1203	926	117	147	210	182	1123	-46
216	670000	-1	59	-34	319	928	56	1842	2438	1024	-139	1269	1284	1272	961	121	157	1330	1178	1178	-45
216	670000	-1	55	-34	339	965	56	1857	2423	1068	-150	1277	1272	1289	961	122	160	1350	1356	1185	-44
216	670000	-3	54	-35	339	993	58	1870	2416	1103	-160	1282	1289	1309	958	121	161	1381	1391	1190	-49
217	700000	0	63	-34	336	1146	64	1988	2485	1254	-203	1347	1360	1387	967	121	173	1436	1470	1242	-44
217	700000	0	77	-41	344	1278	76	2006	2476	1328	-222	1350	1367	1397	971	118	179	1463	1485	1250	-46
218	720000	0	39	-41	328	1497	76	2198	2385	1710	-367	1423	1421	1486	1029	111	173	1605	1576	1617	-40
219	750000	-2	25	-47	339	1518	79	2292	2305	1872	-447	1450	1479	1549	1074	110	168	1840	1730	1850	-42
219	750000	0	27	-54	342	1548	76	2339	2294	1961	-450	1510	1498	1582	1094	110	168	1915	2415	1995	-41
220	770000	0	32	-77	347	1841	65	2514	2102	2348	-609	1530	1538	1619	1181	103	161	2175	3002	2007	-41
220	770000	-4	25	-90	341	1841	56	2572	2051	2471	-672	1534	1561	1634	1210	98	144	2190	3245	1997	-46
221	400000	-2	23	-69	311	1696	88	2287	2058	2326	-586	1289	1289	1389	1122	117	171	1903	2969	1693	8
222	600000	0	25	-77	322	1750	75	2441	1957	2439	-643	1425	1466	1524	1205	93	136	2039	3151	1831	-13
223	750000	0	32	-87	329	1894	69	2610	1926	2569	-716	1556	1608	1677	1309	78	123	2207	3351	2004	-25
224	770000	0	32	-95	330	1923	56	2718	1947	2640	-772	1580	1653	1718	1347	83	130	2262	3372	2025	-27
225	800000	-1	40	-111	341	1944	66	3146	1858	2674	-884	1590	1697	1694	1380	90	140	2189	3402	2037	-21
226	820000	*****	45	-129	343	1958	66	3840	1738	3027	-973	1610	1731	1699	1410	83	131	2199	3423	2053	-17
226	820000	-3	53	-136	348	1967	66	4211	1593	3164	-1021	1939	1759	1699	1409	80	131	2213	3416	2058	-9
226	820000	-1	52	-141	350	1971	65	4305	1526	3254	-1039	1620	1759	1694	1411	82	133	2195	3433	2056	-6
226	820000	-2	55	-144	353	1973	65	4365	1496	3356	-1056	1626	1763	1695	1413	82	132	2203	3469	2060	-10
227	950000	-3	70	-161	358	2008	62	4707	1121	4053	-1199	1695	1791	1700	1419	77	124	2192	5516	2084	-27
227	850000	0	77	-164	356	2013	66	4707	981	4107	-1201	1778	1761	1675	1401	81	130	2120	5484	2034	-17
227	850000	-3	70	-169	344	2006	73	4707	920	4064	-1181	1738	1711	1619	1375	81	139	2060	5419	1980	-10
227	850000	-2	65	-169	340	1996	76	4707	823	4022	-1150	1674	1648	1546	1344	81	145	1999	5348	1918	0
228	550000	-1	62	-164	332	1966	90	4707	663	3988	-1111	1672	1591	1492	1300	71	139	1941	5284	1879	9
228	590000	-5	53	-162	316	1886	96	4707	638	3917	-1072	1470	1457	1371	1251	78	137	1847	5187	1778	15
229	540000	-6	53	-167	326	1873	99	4707	613	3904	-1056	1444	1429	1349	1238	78	137	1823	5155	1750	18
229A	540000	-3	55	-167	329	1873	100	4707	612	3906	-1054	1443	1427	1349	1236	77	138	1824	5152	1745	17
230	600000	-6	60	-174	390	1878	96	4707	516	3943	-1060	1454	1460	1367	1253	55	112	1848	5182	1758	16
231	660000	-5	70	-182	399	1888	96	4707	416	3982	-1065	1482	1518	1402	1279	43	94	1883	5220	1784	16
232	710000	-4	82	-192	413	1938	100	4707	363	4021	-1073	1514	1575	1444	1305	27	60	1933	5267	1814	12
233	608282	-5	98	-210	430	2046	107	4707	235	4117	-1127	1643	1733	1567	1377	12	62	2101	5440	1943	-1
234	608585	-6	101	-214	436	2086	121	4707	195	4223	-1162	1699	1784	1620	1405	3	59	2132	5527	1995	-5
235	608787	-6	102	-220	442	2113	138	4707	115	4963	-1207	1765	1831	1658	1427	3	53	2141	5515	1998	-8
236	609030	-5	109	-221	452	2135	162	4707	46	5316	-1267	1755	1822	1697	1434	-17	57	2168	5489	2036	-15
237	609292	-13	115	-232	477	2221	184	4707	-65	5844	-1424	1768	1830	1712	1431	-43	67	2177	5497	2062	-39
238	609595	-7	139	-217	489	2341	204	4707	-150	6024	-1464	1749	1841	1712	1488	-142	71	2210	5431	2113	-32
239	609696	-10	137	-199	476	2376	216	4707	-222	6024	-791	1722	1841	1659	1480	-165	53	2220	5422	2149	-31
239	609696	-10	141	-185	464	2413	224	4707	-260	6024	-679	1709	1841	1681	1479	-178	43	2228	5460	2161	-45
239	0	-8	145	-171	462	2478	232	4707	-290	6024	-624	1689	1840	1675	1480	-196	33	2215	5502	2170	-60
239	0	-8	150	-161	458	2428	238	4707	-309	6024	-572	1673	1839	1665	1481	-216	26	2225	5530	2185	-69
239	0	-8	152	-149	450	2428	244	4707	-324	6024	-524	1650	1837	1656	1478	-233	21	2217	5570	2194	-83
239	0	-13	154	-140	442	2451	244	4707	-336	6024	-493	1607	1829	1648	1478	-247	8	2177	5522	1848	-82

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
1	70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A	70707	2	-2	0	2	1	1	-2	-1	1	0	-1	0	1	0	1	1	1	1	0	0
2	101010	4	-3	1	7	5	5	-3	-4	0	10	9	9	10	-2	-3	-3	-3	-2	-1	-6
2A	101010	4	-3	0	6	6	0	-3	-2	-1	8	4	9	10	-2	-2	-4	-3	-1	-1	-3
3	121212	2	-3	14	13	9	7	-6	-3	-2	23	12	20	20	-7	-6	-8	-8	-6	-8	-7
3A	121212	2	-2	15	13	10	10	-4	-7	-1	23	19	22	21	-7	-6	-9	-7	-8	-7	-7
4	151515	2	-5	20	21	15	17	-8	-10	-5	35	31	36	34	-11	-13	-12	-14	-9	-11	-10
4A	151515	4	-3	27	22	16	20	-2	-4	-3	37	32	35	34	-12	-13	-13	-14	-9	-10	-8
5	171717	3	-3	34	28	21	26	-12	-9	-8	50	47	50	48	-20	-17	-20	-16	-13	-15	-14
5A	171717	1	-10	34	29	21	27	-12	-8	-10	51	49	49	50	-19	-16	-22	-17	-16	-13	-16
6	202020	4	-8	41	44	35	43	-11	-7	-13	75	76	74	64	-23	-20	-25	-24	-15	-18	-17
6A	202020	4	-8	47	39	34	43	-15	-10	-12	75	72	67	64	-25	-23	-26	-24	-19	-17	-18
7	222222	2	-13	57	50	40	50	-18	-10	-14	108	88	85	81	-40	-26	-31	-27	-23	-20	-22
7A	222222	3	-16	56	46	39	46	-19	-10	-13	315	86	88	80	-35	-27	-35	-27	-22	-14	-22
7B	222222	4	-10	55	49	38	47	-14	-9	-11	328	83	87	84	-33	-25	-32	-27	-24	-19	-21
8	202020	4	-9	45	45	34	44	-14	-7	-12	314	72	77	76	-31	-22	-26	-24	-18	-17	-19
8A	202020	2	-11	47	43	33	44	-13	-9	-13	315	77	76	74	-30	-18	-28	-24	-17	-16	-19
9	151515	3	-2	37	33	24	34	-6	-4	-5	286	58	58	55	-20	-13	-16	-15	-10	-8	-10
9A	151515	4	-5	36	32	21	32	-6	-4	-10	284	57	58	53	-20	-14	-19	-14	-10	-8	-12
10	70707	4	2	15	14	10	16	2	3	1	238	26	28	26	-5	0	0	0	1	3	-1
10A	70707	4	2	15	14	8	16	2	2	3	234	24	25	21	-5	-2	0	-1	2	6	-1
11	70707	18	21	52	49	51	73	25	20	22	274	82	65	51	14	15	35	33	30	39	18
11A	70707	15	21	47	46	48	67	22	23	23	274	79	60	44	14	21	36	31	29	40	17
12	101010	14	19	57	49	51	72	20	17	19	284	85	67	51	11	12	31	26	27	35	12
12A	101010	17	19	53	49	51	67	21	19	20	283	82	68	56	9	15	29	25	27	35	14
13	121212	19	15	53	53	56	72	17	17	19	295	90	75	80	7	7	21	25	23	35	11
13A	121212	20	16	50	53	56	72	17	18	19	295	87	76	68	5	12	26	24	24	33	10
14	151515	18	13	65	58	57	76	14	13	19	310	96	84	89	0	6	20	21	19	27	9
14A	151515	17	12	65	56	58	74	12	13	15	311	95	83	90	1	6	21	21	22	27	9
15	171717	17	12	70	63	61	76	10	13	13	328	101	94	96	-3	2	14	17	17	23	5
15A	171717	18	12	72	62	60	74	10	13	13	327	102	93	95	0	4	17	16	17	20	5
16	202020	19	7	77	67	66	80	8	10	13	344	111	101	86	-7	-2	8	10	12	20	1
16A	202020	20	5	78	67	64	82	6	10	10	344	108	100	105	-8	-3	9	13	10	19	0
17	222222	19	2	83	72	70	82	2	10	9	365	118	111	112	-13	-7	1	9	7	14	-3
17A	222222	16	4	84	72	68	81	5	8	7	364	118	111	112	-13	-5	4	6	9	15	-2
18	202020	17	5	79	68	61	76	5	10	10	352	107	104	106	-8	0	8	13	12	18	1
18A	202020	17	5	77	65	63	74	4	9	10	350	105	100	106	-8	1	10	11	11	17	2
19	171717	17	5	73	61	60	67	9	11	12	335	95	93	96	-2	4	15	16	16	20	5
19A	171717	16	5	70	61	59	64	9	11	14	335	96	93	96	-5	3	13	16	12	18	7
22	121212	17	9	55	48	47	53	15	18	16	302	75	75	74	6	9	21	25	22	24	11
22A	121212	19	11	54	49	46	51	14	15	19	298	70	73	71	9	9	21	23	20	27	9
23	70707	20	15	37	34	35	36	21	21	25	263	47	47	51	17	20	35	34	30	30	20
23A	70707	19	14	37	35	34	36	19	21	27	260	45	46	44	17	17	32	34	29	32	17
24	70707	17	13	34	30	28	26	18	20	23	252	38	39	29	17	20	31	31	27	30	17
24A	70707	17	14	36	28	28	24	19	20	23	250	37	37	31	17	16	31	33	29	27	18
27	100710	16	11	36	31	28	24	19	19	25	255	36	43	26	13	16	28	29	25	25	17
27	100710	17	11	35	30	26	24	17	18	25	253	37	39	36	16	15	31	29	22	23	17
28	120712	16	5	37	33	30	25	15	17	20	260	41	42	28	9	13	26	25	20	20	15
28	120712	15	5	37	33	30	26	17	18	20	261	42	45	31	11	12	26	26	20	20	15
29	150715	14	1	42	36	31	26	17	17	18	266	45	53	42	7	11	21	23	17	18	12
29	150715	17	-1	41	33	31	26	14	17	20	268	45	53	40	9	13	21	23	17	19	12
30	170717	14	-3	43	35	31	27	11	14	19	273	48	57	46	6	9	21	23	12	12	11
30	170717	14	-6	43	37	35	26	14	13	18	275	47	57	38	4	8	21	19	12	13	12
31	200720	17	-5	44	41	36	32	12	16	18	283	51	62	53	3	7	19	17	8	9	12
31	200720	19	-10	44	40	34	26	11	13	17	282	51	60	69	3	7	18	19	9	8	12
32	220722	16	-15	44	43	40	27	11	13	19	286	56	67	70	0	5	15	16	6	4	11
32	220722	19	-15	51	42	38	27	11	15	18	290	55	67	66	-1	5	16	16	6	5	9
33	200720	16	-10	44	39	33	26	11	17	19	283	52	63	60	4	7	18	16	7	7	12
33	200720	16	-4	47	39	35	23	12	15	18	282	51	60	59	2	7	18	16	7	8	10
34	170717	16	-7	42	33	30	22	12	18	18	275	44	54	56	4	7	20	18	9	7	11
34	170717	14	-7	40	34	31	22	12	17	19	274	43	54	48	6	10	21	18	10	7	12

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
35	150715	15	-1	37	30	28	17	12	17	19	264	38	50	38	8	7	21	21	12	8	12
35	150715	16	-2	37	29	25	17	11	18	23	272	41	50	37	8	9	21	20	12	9	12
36	120712	14	3	34	28	23	16	16	18	20	255	34	42	26	10	11	24	23	16	12	12
36	120712	16	1	34	27	23	14	11	13	22	253	35	44	24	9	13	23	23	18	12	15
37	100710	14	4	27	24	20	14	17	21	22	247	30	36	16	12	15	29	25	19	16	15
37	100710	16	9	31	24	20	14	19	17	22	248	29	37	11	14	16	29	25	18	16	16
38	70707	21	17	31	25	26	22	23	25	25	255	46	40	21	13	16	36	29	26	28	18
38	70707	23	17	34	33	23	32	22	24	23	254	46	39	24	13	17	33	26	24	27	18
41	70707	17	16	37	35	31	32	20	25	19	279	72	57	48	7	10	41	25	25	38	12
41	70707	17	19	36	36	30	31	21	23	18	278	70	55	46	9	11	41	26	25	37	12
42	71007	19	22	40	39	32	31	20	25	20	282	69	60	51	3	7	40	23	22	38	11
42	71007	18	21	39	36	33	29	20	23	19	282	69	58	50	5	7	41	24	21	38	11
43	71207	18	23	37	37	31	29	20	23	19	285	70	59	51	5	7	41	23	22	38	12
43	71207	18	21	40	36	30	44	20	23	18	283	65	58	48	4	7	41	24	22	37	12
44	71507	20	24	37	35	30	47	19	22	17	285	68	61	51	4	7	39	23	24	36	9
44	71507	19	23	36	35	28	46	17	20	17	287	66	59	51	2	7	39	21	21	33	9
45	71707	17	24	37	23	31	44	16	20	18	289	65	60	54	3	5	35	21	22	32	6
45	71707	16	23	36	26	28	44	15	22	15	290	62	63	54	0	5	37	17	21	32	6
46	72007	18	25	37	26	30	41	17	23	17	295	67	67	57	0	5	36	19	21	30	5
46	72007	17	25	41	28	31	40	15	20	17	295	65	65	57	0	5	34	16	22	30	5
47	72207	18	26	40	29	30	40	12	16	15	304	66	68	60	-2	4	33	18	22	27	1
47	72207	22	25	40	29	30	40	12	20	15	303	67	68	61	0	4	31	15	20	25	1
48	72007	16	25	36	22	28	36	15	21	17	294	62	60	54	0	7	35	16	20	26	6
48	72007	18	23	35	24	26	34	14	20	17	298	60	60	56	0	7	34	21	20	25	2
49	71707	17	25	34	21	21	30	15	22	18	288	56	56	51	2	7	38	23	20	24	7
49	71707	19	22	34	18	21	30	14	20	20	287	52	59	49	2	5	33	20	21	26	7
50	71507	16	22	21	17	22	27	17	22	19	281	47	51	40	7	9	38	15	23	25	9
50	71507	16	22	22	18	20	27	16	22	20	280	48	50	43	5	7	39	23	22	24	8
51	71207	17	28	17	8	13	17	20	26	21	252	27	32	31	12	16	50	30	29	30	15
51	71207	17	23	26	13	16	22	19	31	23	272	41	45	48	7	13	41	26	24	25	12
52	70707	17	17	17	8	11	16	22	26	25	259	30	38	28	12	16	47	31	23	27	19
52	70707	16	18	17	9	14	16	22	27	24	255	29	36	24	13	15	47	28	22	25	17
1A	70707	15	16	12	3	8	8	20	26	26	252	24	28	14	11	16	44	26	19	20	12
2A	101010	16	13	17	6	9	10	19	23	25	263	30	39	41	8	12	39	25	17	19	12
3A	121212	17	10	23	12	14	16	16	21	20	278	38	46	51	3	5	37	19	12	13	8
4A	151515	14	5	30	16	18	18	13	20	20	294	47	55	62	-1	3	32	16	9	10	2
5A	171717	17	3	36	23	20	22	9	16	17	310	57	65	70	-7	0	26	12	7	3	1
6A	202020	17	2	42	26	24	27	2	13	14	328	67	76	82	-11	-4	21	6	3	-2	-1
7A	222222	16	-2	47	31	29	31	1	13	10	350	75	86	93	-18	-10	17	4	-3	-6	-7
8A	202020	14	0	41	27	24	26	2	13	13	335	67	79	82	-10	-4	20	6	-1	-3	-7
9A	171717	17	5	34	22	19	26	8	19	17	321	56	67	74	-5	-1	21	11	2	-1	0
10A	151515	13	5	26	12	16	16	9	20	20	302	44	55	61	-3	2	29	13	6	2	2
11A	121212	13	6	17	8	11	12	11	21	22	274	32	44	54	2	6	35	16	10	3	5
12A	101010	13	10	12	3	6	7	14	20	23	272	27	35	42	6	7	37	21	12	8	7
13A	70707	14	13	10	-2	4	10	18	23	27	254	25	26	31	9	12	41	25	15	10	12
76	70707	18	24	29	19	22	43	30	33	31	280	56	53	45	14	17	67	39	33	40	16
77	121212	16	21	41	33	34	47	25	27	29	311	76	74	64	4	13	55	31	20	35	11
77A	151515	17	18	47	34	40	52	21	30	27	323	81	83	71	3	11	52	29	21	29	7
78	171717	18	14	50	40	41	50	20	26	25	344	92	88	80	0	6	46	26	20	27	7
78A	202020	19	10	55	43	44	55	16	24	20	350	92	99	96	-4	2	40	22	12	23	2
79	222222	19	10	66	44	49	58	14	23	19	368	99	110	106	-10	-1	38	20	11	16	0
80	252525	18	5	72	53	52	62	12	21	19	391	111	123	115	-17	-5	31	16	6	10	-5
80A	252525	17	5	69	53	51	62	10	22	17	393	111	120	116	-15	-6	30	14	7	10	-2
81	272727	16	4	75	57	55	64	6	19	15	414	117	134	114	-23	-10	21	11	1	5	-9
81A	272727	18	4	79	58	55	64	7	18	13	413	121	134	120	-21	-13	21	9	0	6	-8
82	303030	18	2	75	59	60	67	7	16	10	439	126	148	102	-28	-16	12	2	-4	-4	-14
82A	303030	17	1	77	58	58	68	2	18	12	442	126	150	113	-29	-18	11	0	-8	-4	-15
83	323232	19	-5	86	63	61	72	0	12	7	466	140	170	148	-36	-25	1	-5	-11	-12	-22
83A	323232	18	-3	86	66	64	69	0	15	7	466	142	172	162	-36	-25	1	0	-11	-12	-20
84	353535	19	-5	87	65	64	77	0	16	5	475	428	317	220	-43	-43	-2	1	-20	-19	-30
84A	353535	18	-3	87	69	64	78	0	13	7	473	429	323	227	-43	-43	-2	0	-20	-19	-29

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
84B	353535	17	-7	89	67	66	77	-2	12	7	473	440	333	233	-43	-45	-4	-3	-22	-22	-32
84C	353535	18	-5	87	66	66	77	-2	15	3	473	442	338	236	-45	-45	-4	-1	-23	-20	-30
85	373737	16	-8	94	72	71	83	-5	10	2	498	467	373	256	-52	-52	-13	-7	-27	-26	-38
85A	373737	15	-6	95	75	70	84	-6	13	3	500	469	377	256	-51	-53	-13	-7	-27	-28	-36
86	353535	19	-7	90	67	68	78	-5	13	5	485	457	372	249	-41	-47	-5	0	-25	-26	-32
87	323232	16	-4	83	62	60	70	0	13	5	468	440	360	236	-40	-48	-2	2	-22	-22	-31
88	303030	16	0	76	56	53	65	1	19	9	452	427	349	227	-34	-40	1	6	-18	-19	-27
89	272727	18	3	71	53	50	60	5	21	13	435	410	335	215	-28	-34	9	10	-13	-13	-22
90	252525	17	5	67	48	43	53	8	22	18	416	392	323	201	-24	-32	18	14	-10	-10	-17
91	222222	15	11	57	40	40	46	11	24	16	399	376	310	194	-18	-26	19	20	-8	-5	-16
91A	202020	18	10	51	38	34	40	12	26	20	380	360	296	182	-11	-18	26	24	0	-1	-10
92	171717	17	14	50	33	30	36	17	30	25	363	342	284	169	-8	-15	31	31	3	3	-7
92A	151515	18	15	41	24	23	27	21	31	27	343	321	267	157	0	-10	38	34	9	7	-3
93	121212	14	21	33	20	18	26	24	33	30	325	304	252	144	4	-5	44	40	12	10	2
94	70707	17	27	20	6	8	16	33	40	35	283	262	218	118	14	4	56	46	20	18	10
95	70707	13	33	34	17	24	50	32	41	33	315	307	266	145	11	3	73	53	29	22	10
95A	121212	16	26	44	23	34	57	24	38	31	345	339	270	164	3	-6	62	43	20	16	6
96	171717	14	22	54	28	37	64	22	33	27	377	363	292	185	-7	-13	54	36	12	7	-3
96A	222222	17	18	65	42	49	74	18	31	20	414	400	325	215	-15	-23	41	30	4	1	-12
97	272727	18	10	77	53	59	82	11	28	17	451	432	354	237	-27	-32	32	19	-4	-8	-17
97A	323232	14	5	87	63	64	89	5	23	10	484	467	389	261	-39	-39	19	12	-13	-5	-27
97B	353535	14	3	95	67	69	95	2	20	9	504	488	409	277	-42	-47	11	6	-16	-7	-30
98	373737	16	0	102	74	71	96	0	20	13	530	510	440	292	-46	-52	1	0	-24	-14	-35
99	373232	16	5	81	53	56	77	7	23	13	526	507	448	295	-43	-47	4	6	-28	-14	-30
100	372727	17	10	66	35	40	59	14	28	19	515	497	443	288	-40	-43	6	10	-27	-17	-28
100A	372727	17	9	69	37	38	57	14	31	13	515	497	443	287	-21	-44	4	11	-27	-17	-27
100B	372727	18	10	61	29	30	51	11	30	20	512	490	437	260	-37	-45	6	12	-27	-22	-26
100C	372727	16	10	67	29	28	50	12	31	20	512	490	437	262	-39	-46	5	9	-28	-20	-27
101	372222	17	14	59	33	35	57	19	36	27	505	481	433	254	-33	-39	8	12	-27	-19	-22
101A	372222	14	13	45	13	16	36	18	33	26	505	482	432	256	-35	-41	8	14	-27	-21	-22
102	371717	18	23	26	0	1	22	30	43	35	496	471	432	247	-31	-38	10	12	-27	-20	-18
102A	371717	15	20	26	-2	-2	12	27	38	34	493	469	425	250	-31	-37	11	15	-27	-21	-17
102B	371515	17	22	17	-12	-10	3	32	45	39	487	459	420	244	-27	-35	13	16	-27	-22	-17
102C	371515	17	22	17	-11	-10	4	32	46	40	485	457	420	255	-26	-33	16	19	-27	-21	-13
103	371212	17	25	7	-19	-20	-6	37	47	43	482	451	419	249	-23	-32	16	19	-27	-21	-12
103A	371212	17	25	6	-22	-20	-6	37	48	45	479	450	417	257	-23	-33	16	20	-28	-24	-13
103B	371010	16	27	0	-28	-24	-16	41	50	45	475	447	415	257	-23	-32	18	21	-28	-20	-13
103C	371010	12	28	-1	-28	-24	-16	39	50	47	473	445	417	253	-23	-29	16	20	-26	-22	-11
104	370707	15	30	-10	-37	-32	-24	45	53	49	469	441	411	240	-21	-30	20	20	-27	-24	-12
104A	370707	14	29	-12	-38	-34	-24	46	53	50	470	439	410	243	-22	-30	19	20	-27	-24	-12
105	320707	21	30	-6	-34	-29	-18	42	53	50	445	418	393	229	-15	-24	26	26	-21	-19	-7
106	270707	14	30	-5	-31	-26	-16	40	53	48	416	389	367	206	-3	-21	36	33	-12	-13	-2
107	220707	18	30	-2	-27	-20	-9	40	49	48	391	367	349	190	0	-13	41	39	-3	-3	1
108	150707	14	30	7	-18	-14	-4	37	48	45	345	325	308	151	13	-2	55	49	10	7	10
109	70707	16	32	12	-11	-6	5	35	44	43	297	284	267	128	23	5	69	59	22	17	16
114A	70707	11	44	45	26	36	63	41	55	59	331	339	300	177	30	17	124	91	49	60	22
115	120712	12	34	47	26	40	65	40	52	57	348	350	316	189	27	15	121	86	45	57	21
116	170717	12	25	50	28	42	65	37	53	55	360	362	327	195	22	7	113	86	34	49	17
117	220722	11	17	57	33	44	67	35	50	53	380	376	345	206	18	5	108	79	29	40	12
118	250725	13	11	62	35	46	66	32	48	52	388	382	352	208	13	4	105	77	25	38	13
119	270727	12	7	64	36	46	66	31	47	47	395	389	360	227	13	0	99	73	21	32	11
120	300730	11	1	65	35	48	64	31	47	47	405	397	368	225	12	-3	97	71	16	28	10
121	320732	19	-5	71	39	50	66	30	44	49	414	401	375	237	7	-3	93	71	11	20	10
122	350735	10	-7	72	42	51	66	24	44	49	422	411	385	240	7	-5	89	66	9	20	7
123	370737	12	-15	73	43	53	62	24	43	47	430	415	392	237	5	-6	86	66	2	15	8
123A	400740	12	-21	75	46	54	62	22	42	44	435	417	396	250	3	-9	79	65	0	8	9
123B	370737	11	-16	67	41	48	58	25	45	45	428	408	390	240	5	-5	81	65	2	10	7
123C	370737	10	-20	61	37	40	42	24	45	49	415	390	379	224	7	-5	81	64	1	7	10
124	350735	11	-15	57	33	37	40	29	48	51	405	379	369	226	11	-3	84	68	6	8	12
125	320732	12	-10	54	26	34	35	31	50	53	394	370	357	218	15	1	89	66	8	13	14
126	300730	13	-5	51	23	30	32	32	52	52	384	358	347	207	17	3	91	73	12	15	12

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
127	270727	12	-2	44	18	26	26	36	52	55	371	345	338	203	19	6	97	74	16	15	17
128	250725	12	2	37	13	20	22	34	52	57	361	332	325	190	22	7	98	76	17	18	18
129	220722	12	5	32	10	15	16	37	52	56	350	319	310	184	26	10	101	79	21	20	20
130	170717	13	17	26	0	9	7	42	55	60	328	296	293	170	33	15	108	83	30	25	23
131	120712	12	25	16	-8	0	-2	47	53	60	308	274	273	150	38	19	112	86	39	33	22
132	70707	9	38	7	-14	-6	-11	44	60	63	282	249	249	130	43	26	121	92	46	37	27
133	70707	15	45	4	-21	-10	-3	52	65	64	302	286	272	152	39	18	136	92	42	46	25
134	71207	18	49	2	-17	-4	2	53	62	63	314	298	283	161	36	15	131	86	41	43	19
135	71707	14	54	12	-13	-4	4	43	60	60	329	314	293	170	29	11	126	84	41	40	13
136	72207	19	59	16	-8	-2	7	41	56	59	345	331	308	181	29	7	121	82	39	38	10
137	72507	11	60	20	-7	1	8	38	58	56	352	337	313	184	24	6	121	78	39	37	6
137A	202520	14	38	37	8	14	24	32	52	50	405	382	356	218	9	-6	108	66	21	23	0
138	202720	16	40	42	13	15	26	31	52	50	413	392	364	227	7	-7	101	66	21	20	-2
139	203020	16	43	42	16	20	25	30	51	50	420	398	369	229	8	-7	100	65	22	22	-3
140	203220	16	44	47	17	21	29	30	51	48	431	409	378	233	4	-10	99	64	22	18	-5
141	203520	14	45	51	23	23	27	28	51	45	436	419	386	239	5	-13	97	64	21	16	-8
142	203720	14	51	52	23	27	32	27	51	47	445	431	395	244	2	-13	96	60	21	17	-8
142A	173717	10	45	45	20	21	21	22	46	45	432	427	389	238	-1	-17	90	59	19	11	-12
142B	153715	13	53	44	18	17	18	26	51	47	425	422	386	230	2	-11	95	62	19	14	-10
142C	153715	15	53	40	13	16	14	27	52	50	418	411	378	226	7	-10	98	63	24	13	-9
143	153515	14	55	37	10	14	14	29	53	49	410	404	372	219	9	-6	104	66	25	18	-7
144	153215	14	54	36	9	10	8	31	53	52	401	399	365	217	8	-5	103	66	27	19	-4
145	153015	16	53	33	7	8	5	33	57	52	393	386	357	213	11	-4	105	70	27	19	0
146	152715	15	52	27	4	6	2	32	58	55	385	380	353	206	15	-3	110	66	27	20	1
147	152515	15	51	25	0	-1	-1	36	60	57	375	368	344	199	18	0	112	73	27	20	4
147A	72507	18	63	14	-12	-9	-11	39	62	60	340	336	315	176	25	7	124	83	39	30	7
148	72207	16	62	10	-14	-10	-16	42	62	60	332	327	310	170	29	7	125	83	38	30	10
149	71707	15	59	2	-18	-16	-24	42	65	65	314	305	297	159	33	15	130	86	42	32	16
150	71207	17	59	-3	-22	-20	-28	49	67	70	295	286	279	149	38	21	137	93	44	36	20
151	70707	18	52	-8	-30	-26	-33	50	70	70	280	266	262	138	43	24	139	96	44	37	28
152	70707	14	60	-10	-30	-20	-26	59	76	80	288	269	268	138	47	24	159	111	51	43	32
152A	120000	16	56	4	-19	-9	-16	52	74	75	324	306	297	163	39	25	149	102	42	37	25
153	170000	17	52	17	-5	1	-4	49	73	72	362	346	330	188	27	17	138	94	35	27	16
153A	220000	16	45	32	6	11	5	42	70	65	397	384	363	209	19	7	126	86	29	20	8
154	270000	16	42	44	18	23	16	35	58	60	435	415	395	236	9	-3	114	79	19	14	2
154A	300000	18	46	55	23	30	31	35	60	54	463	450	424	253	3	-5	131	71	11	8	-6
154B	320000	19	35	62	32	36	34	32	59	52	481	462	440	265	-1	-13	101	66	8	4	-10
154C	350000	18	34	68	40	40	42	27	53	51	510	492	471	283	-10	-18	94	61	4	0	-11
155	370000	19	29	77	47	45	51	22	53	49	535	518	493	296	-16	-25	86	54	-3	-3	-17
156	400000	17	28	86	54	49	61	17	48	49	571	552	513	321	-27	-32	75	46	-14	-16	-31
156A	400000	17	25	90	58	48	67	16	42	44	592	577	527	330	-33	-37	69	46	-15	-20	-38
157	420000	19	25	97	64	51	72	14	40	40	622	605	550	347	-40	-43	63	42	-21	-25	-41
158	450000	19	17	115	55	61	64	12	19	29	747	778	675	570	-69	-68	56	31	-50	-42	-47
158	450000	19	15	116	57	64	64	12	12	27	750	783	680	577	-73	-72	56	26	-49	-42	-48
158	450000	19	16	117	58	64	65	10	13	25	752	787	683	579	-73	-68	57	26	-49	-43	-47
159	420000	17	22	111	53	61	61	14	16	28	738	771	670	568	-67	-63	64	34	-45	-40	-43
160	400000	18	23	105	49	58	57	18	15	33	719	751	653	554	-61	-60	70	41	-40	-34	-38
161	370000	17	25	97	43	54	49	19	19	32	700	731	635	541	-57	-53	76	45	-37	-28	-34
161A	370000	18	23	94	40	53	47	19	18	35	699	731	630	538	-57	-55	78	46	-35	-32	-33
161B	370000	17	25	106	47	64	60	17	16	32	715	749	649	550	-55	-52	81	46	-33	-23	-32
161C	370000	16	28	125	70	82	84	20	12	37	723	769	667	570	-52	-49	90	62	-25	-14	-34
161D	370000	13	26	115	64	80	77	20	10	38	710	742	645	558	-50	-46	93	66	-23	-15	-32
161E	370000	12	25	113	63	77	76	19	10	35	712	740	646	560	-50	-46	94	64	-23	-16	-32
162	350000	14	30	103	61	73	70	22	13	39	695	722	635	548	-46	-39	102	69	-18	-10	-25
163	320000	16	31	97	54	71	64	22	12	40	673	701	617	530	-38	-35	110	71	-14	-6	-22
164	270000	14	37	90	45	64	53	27	20	45	635	656	580	500	-25	-28	121	86	-2	6	-12
165	220000	12	44	77	33	56	43	32	21	52	593	612	545	468	-14	-15	137	94	9	15	-2
166	170000	14	51	64	30	50	34	37	25	55	544	561	500	428	2	0	153	106	22	28	7
167	120000	14	58	49	18	43	22	42	29	62	495	512	460	394	16	12	168	121	32	40	19
168	70000	16	65	36	8	31	17	42	31	65	445	459	416	356	29	20	179	130	44	52	29
169	120000	14	61	52	20	41	26	39	28	58	483	500	446	385	19	11	167	123	38	42	20

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
169A	120000	14	66	51	20	37	27	39	28	60	484	502	446	387	18	12	166	123	37	45	20
170	170000	14	55	67	30	45	36	35	25	55	524	549	482	422	9	2	156	109	26	32	10
171	220000	15	47	77	38	51	47	29	19	47	569	598	523	454	-5	-11	138	102	15	20	1
171A	220000	13	47	97	46	61	64	30	18	49	583	618	539	469	-5	-13	151	105	17	28	-2
172	252222	16	50	95	43	58	59	32	19	53	599	628	555	479	-7	-13	150	102	12	23	-6
172	272222	14	46	95	43	60	57	30	19	49	599	627	556	480	-7	-14	149	101	12	23	-5
173	302222	14	46	91	40	56	50	32	23	50	608	631	565	485	-11	-14	145	100	8	18	-6
174	322222	15	45	87	33	51	46	35	23	53	615	641	573	493	-16	-19	139	97	1	14	-7
175	352222	15	45	83	31	47	37	35	25	53	629	644	583	499	-20	-20	137	94	-2	8	-7
176	372222	14	43	77	28	43	34	36	22	54	642	655	595	509	-25	-25	134	90	-10	-2	-12
177	352222	12	45	77	23	39	33	38	28	55	655	671	606	520	-28	-29	130	86	-18	-5	-12
178	322222	14	47	79	26	42	31	39	25	55	647	659	595	510	-24	-25	134	88	-9	-1	-9
179	292222	13	47	79	27	41	32	34	23	52	632	646	579	499	-20	-25	138	92	-3	3	-4
180	272222	14	45	79	29	43	37	36	22	51	615	629	563	480	-22	-19	141	94	0	6	-7
181	252222	14	45	79	29	43	31	34	23	53	601	611	548	470	-13	-15	146	99	5	9	-4
182	222222	15	45	79	30	45	29	32	20	52	584	595	533	456	-8	-13	151	104	9	15	-1
183	222222	16	45	76	30	45	30	35	21	50	570	580	517	448	-5	-10	156	102	17	19	2
183A	222222	13	43	72	24	38	21	31	21	49	564	572	508	429	-4	-9	154	105	12	15	1
184	250000	14	42	76	26	41	27	29	18	49	582	592	522	439	-11	-16	149	103	10	10	-3
185	270000	14	39	77	30	40	27	25	12	43	601	612	536	450	-17	-21	140	92	2	3	-8
186	300000	14	33	85	33	47	31	20	12	43	623	630	555	478	-22	-26	136	87	-3	-1	-11
187	320000	14	30	87	37	48	36	17	11	40	644	655	574	495	-30	-32	127	83	-8	-10	-18
188	350000	13	25	90	42	54	40	14	8	35	668	676	594	513	-34	-36	121	76	-13	-13	-21
189	370000	12	22	101	46	58	39	12	3	32	687	698	611	529	-43	-44	115	71	-22	-20	-28
189A	370000	15	20	107	50	57	40	15	6	34	685	693	608	523	-41	-44	116	70	-24	-20	-25
189B	370000	18	25	134	-241	98	107	12	3	27	740	790	675	580	-53	-53	119	66	-26	-5	-38
189C	370000	13	22	137	77	96	111	7	-1	25	748	798	684	573	-56	-59	124	66	-25	-3	-43
189D	370000	15	20	141	78	100	115	6	-2	23	748	803	686	590	-56	-63	127	63	-27	-3	-42
189E	370000	14	15	157	94	116	137	8	-3	30	755	818	697	610	-55	-62	138	74	-21	5	-43
189E	370000	14	17	157	95	116	136	7	-4	29	756	819	698	610	-54	-62	139	72	-20	6	-44
189F	370000	14	11	157	93	118	138	8	-7	29	747	805	690	602	-54	-58	141	76	-23	0	-42
189F	370000	14	12	156	97	120	126	7	-7	30	748	800	689	600	-52	-57	141	74	-21	0	-42
189G	370000	14	13	160	97	118	133	7	-8	29	750	807	694	586	-53	-58	141	73	-19	4	-42
189H	370000	13	5	162	100	118	131	2	-7	27	749	805	691	610	-57	-63	149	74	-22	0	-47
190	400000	12	5	167	103	123	138	5	-7	23	768	822	705	627	-60	-66	141	70	-27	-2	-50
191	420000	12	3	170	107	121	134	1	-14	20	790	842	725	642	-72	-75	139	64	-38	-6	-52
192	450000	12	-2	175	110	129	140	-4	-17	16	813	865	740	660	-77	-82	129	56	-40	-14	-59
193	470000	12	-5	184	115	130	142	-8	-20	15	843	896	768	686	-90	-88	121	49	-49	-22	-67
193	470000	14	-6	184	113	130	145	-8	-17	14	842	895	770	688	-89	-90	119	46	-48	-23	-67
194	500000	12	-11	190	119	136	151	-8	-22	8	875	932	801	719	-100	-99	111	41	30470	-28	-73
194	500000	12	-9	193	118	138	152	-11	-24	8	879	932	805	722	-100	-97	112	36	-58	-29	-72
195	500000	14	14	150	92	103	106	10	-8	29	709	765	668	594	-44	-53	167	83	-17	9	-35
196	400000	14	3	169	103	122	126	0	-17	17	785	845	734	655	-71	-74	139	63	-37	-10	-52
197	450000	14	-5	183	112	131	136	-4	-18	12	828	884	768	683	-85	-85	123	52	-47	-22	-63
198	500000	14	-10	195	120	139	146	-10	-27	5	873	930	809	723	-100	-97	110	39	-61	-36	-72
199	520000	14	-15	210	128	144	150	-12	-28	0	913	967	845	757	-113	-107	101	32	-70	-43	-78
199	520000	14	-15	208	128	144	149	-14	-31	0	915	969	852	767	-115	-107	99	31	-76	-44	-84
200	550000	13	-15	776	133	146	156	-14	-31	-4	953	981	875	798	-130	-115	89	22	-83	-56	-91
200	550000	14	-16	1002	138	148	159	-15	-32	-3	963	984	881	810	-133	-117	88	22	-87	-54	-91
200	550000	13	-18	1013	140	148	156	-15	-31	0	1009	1011	897	823	-141	-122	81	18	-93	-61	-92
200A	550000	12	-17	1030	140	146	156	-14	-33	0	1018	1029	912	830	-143	-123	81	15	-91	-62	-94
200A	550000	14	-17	1162	143	150	706	-13	-33	4	1015	1029	918	845	-146	-129	81	15	-98	-67	-95
200A	550000	14	-34	1174	151	168	737	-20	-42	3	1035	1044	952	867	-156	-133	72	10	-107	-72	-107
200A	550000	12	-26	1206	1185	843	755	-15	-128	3	1035	1030	956	853	-151	-126	75	14	-99	-69	-100
200A	550000	14	-25	1201	1212	860	761	-18	-133	2	1032	1027	958	850	-151	-127	73	16	-100	-66	-100
200B	550000	14	-27	1203	1220	868	762	-7	-130	0	1047	1042	970	864	-155	-132	69	11	-107	-73	-103
201	400000	13	-6	1107	1110	810	705	10	-111	17	925	922	864	770	-113	-98	116	45	-71	-39	-73
202	200000	14	23	901	906	635	591	35	-80	32	725	732	685	618	-45	-41	166	94	-15	18	-28
202A	200000	12	24	901	904	695	605	35	-75	29	735	703	694	617	-47	-42	178	95	-15	32	-30
203	300000	12	12	961	983	736	643	24	-87	20	815	839	767	680	-73	-61	141	76	-34	7	-48
204	400000	13	-3	1075	1084	788	693	15	-102	10	915	937	856	756	-105	-92	117	51	-60	-19	-71

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 61	CHAN 62	CHAN 63	CHAN 64	CHAN 65	CHAN 66	CHAN 67	CHAN 68	CHAN 69	CHAN 70	CHAN 71	CHAN 72	CHAN 73	CHAN 74	CHAN 75	CHAN 76	CHAN 77	CHAN 78	CHAN 79	CHAN 80
205	500000	14	-18	1186	1196	855	758	2	-117	0	1018	1035	951	836	-139	-116	94	26	-88	-45	-92
206	520000	12	-24	1216	1230	877	778	2	-123	-1	1046	1059	978	860	-148	-125	88	17	-97	-52	-98
207	550000	14	-26	1252	1272	907	802	1	-129	-4	1078	1089	1007	890	-160	-133	81	11	-102	-59	-104
208	570000	14	-35	1325	1362	958	836	-8	-140	-6	1122	1128	1043	922	-171	-140	77	6	-107	-66	-108
208	570000	14	-35	1391	1383	978	849	-7	-146	-7	1109	1132	1049	920	-173	-142	74	5	-109	-66	-108
208	570000	14	-35	1407	1392	986	851	-4	-146	-6	1113	1134	1048	926	-174	-141	73	6	-110	-69	-110
209	370000	14	-7	1252	1220	893	763	20	-117	13	942	964	897	789	-115	-90	125	52	-60	-19	-71
209	370000	14	-9	1246	1219	895	763	22	-117	10	941	960	895	789	-114	-93	125	51	-61	-19	-70
210	500000	14	-24	1339	1330	950	816	9	-131	-1	1049	1066	990	874	-148	-122	88	24	-89	-49	-96
211	550000	12	-35	1387	1377	984	852	2	-142	-5	1093	1111	1034	908	-166	-137	75	9	-97	-53	-107
212	570000	15	-35	1436	1427	1007	864	-2	-149	-8	1125	1146	1060	940	-174	-144	68	4	-113	-71	-113
213	600000	13	-48	1636	1540	1093	919	6	-160	-10	1155	1205	1123	997	-187	-153	50	-2	-119	-81	-137
213	600000	14	-49	1698	1552	1108	934	2	-157	-11	1165	1229	1139	1009	-188	-157	48	-3	-120	-84	-139
213	600000	14	-47	1705	1552	1110	936	2	-157	-10	1170	1232	1137	1010	-190	-158	48	-5	-122	-86	-140
213	600000	13	-49	1712	1557	1119	946	7	-153	-13	1163	1235	1142	1014	-190	-159	47	-4	-119	-84	-140
214	620000	13	-34	1929	1662	1175	1051	-3	-177	-24	1190	1262	1176	1119	-201	-167	31	-16	-133	-99	-156
214	620000	14	-34	1937	1662	1180	1062	-1	-177	-23	1203	1262	1179	1112	-204	-168	30	-18	-134	-99	-160
215	650000	14	-21	2117	1772	1290	1266	21	-201	-87	1275	1322	1228	1159	-230	-183	4	-32	-158	-123	-167
215	650000	14	-20	2141	1779	1308	1276	22	-203	-89	1275	1328	1233	1165	-234	-183	5	-34	-158	-125	-167
216	670000	13	-20	2146	2180	1444	1363	50	-235	-101	1358	1356	1307	1195	-256	-194	-19	-44	-182	-151	-190
216	670000	12	-18	2135	2163	1448	1373	58	-237	-102	1365	1355	1308	1197	-261	-195	-16	-42	-187	-153	-192
216	670000	11	-18	2114	2144	1448	1386	60	-241	-104	1375	1355	1308	1197	-263	-197	-16	-44	-190	-159	-193
217	700000	12	-17	2123	2171	1508	1573	71	-239	-110	1408	1372	1354	1233	-295	-216	-23	-51	-215	-187	-212
217	700000	14	-15	2127	2136	1550	1582	77	-243	-98	1415	1372	1369	1233	-301	-223	-24	-55	-224	-194	-214
218	720000	14	2	2091	2162	1621	1684	87	-249	-60	1457	1389	1367	1279	-340	-237	-28	-64	-253	-230	-239
219	750000	13	10	2116	2200	1644	1710	82	-257	-10	1487	1391	1388	1270	-376	-248	-39	-72	-278	-259	-261
219	750000	12	15	2257	2192	1654	1724	76	-263	7	1508	1391	1393	1275	-390	-247	-35	-75	-287	-269	-265
220	770000	13	60	4707	2217	1678	1744	47	-267	-24	1520	1388	1391	1279	-415	-257	-35	-90	-318	-302	-292
220	770000	10	60	6637	1792	1665	1742	32	-272	-35	1521	1377	1376	1267	-431	-266	-37	-96	-332	-320	-305
221	400000	12	133	6637	202	1311	1374	76	-166	47	1164	1047	1055	977	-265	-135	126	26	-207	-162	-209
222	600000	11	111	6637	332	1500	1577	47	-216	8	1360	1228	1228	1130	-351	-203	58	-37	-270	-237	-267
223	750000	10	95	6637	666	1685	1766	12	-263	-33	1536	1392	1394	1277	-448	-276	-9	-103	-346	-320	-327
224	770000	10	94	6637	-1128	1707	1790	-2	-276	-43	1571	1411	1424	1313	-475	-285	-19	-120	-374	-355	-350
225	800000	14	95	6637	-538	1739	1794	-37	-286	-44	1575	1420	1427	1313	-501	-304	-10	-146	-413	-401	-370
226	820000	13	67	6637	-627	1765	1790	-67	-297	-40	1595	1436	1465	1337	-550	-335	-15	-185	-482	-480	-402
226	820000	12	39	6637	-755	1770	1794	-62	-299	-35	1585	1410	1444	1320	-560	-342	5	-193	-497	-501	-402
226	820000	12	31	6637	-837	1765	1792	-55	-298	-35	1566	1382	1416	1297	-550	-332	21	-183	-484	-490	-398
226	820000	13	15	6637	-985	869	1794	-57	-301	-34	1569	1393	1417	1307	-561	-342	21	-183	-500	-504	-407
227	850000	11	-70	6637	-710	1835	1829	-72	-328	-23	1398	1280	1292	1166	-515	-329	81	-146	-508	-517	-448
227	850000	12	-74	6637	-711	1810	1796	-60	-311	-5	1238	1156	1163	1027	-480	-292	78	-133	-414	-472	-450
227	850000	12	-69	6637	-969	1776	1743	-49	-298	4	1132	1026	1054	937	-460	-242	111	-126	-319	-410	-422
227	850000	10	-58	6637	-977	1702	1655	-39	-277	15	1061	934	980	876	-450	-226	123	-114	-242	-364	-403
228	550000	11	-54	6637	-978	1520	1446	-38	-259	20	995	831	896	810	-443	-219	125	-108	-124	-313	-392
228	550000	8	-52	6637	-1017	1447	1413	-31	-229	30	958	779	859	790	-428	-211	121	-87	-88	-288	-387
229	540000	12	-47	6637	-1129	1420	1381	-30	-227	31	939	755	837	783	-413	-203	118	-94	-36	-277	-381
229A	540000	14	-44	6637	-1150	1417	1378	-28	-226	30	940	755	839	783	-409	-204	125	-93	-34	-273	-378
230	600000	9	-48	6637	-1272	1445	1416	-52	-244	15	958	762	846	790	-401	-212	101	-100	18	-207	7992
231	660000	12	-47	6637	-1328	1513	1474	-77	-264	1	990	784	862	808	-391	-213	90	-108	17	-135	7992
232	710000	12	-54	6637	-1355	1595	1533	-94	-292	-12	1020	825	878	840	-400	-223	81	-113	22	-92	7992
233	608292	11	-68	6637	-1380	1800	1760	-147	-348	-67	999	808	849	815	-371	-209	110	-88	28	-73	7992
234	608585	12	-82	6637	-1404	1887	1784	-167	-420	-72	964	779	812	788	-361	-198	126	-74	32	-69	7992
235	608787	12	-108	6637	-1460	1850	1781	-198	-594	-68	898	722	740	738	-346	-180	155	-62	39	-61	7992
236	609090	12	-157	6637	-1460	1840	1812	-244	-713	-81	835	646	660	666	-337	-163	177	-45	47	-55	7992
237	609292	8	-216	6637	-1443	1809	1795	-295	-816	-100	715	517	573	590	-332	-142	179	-35	46	-59	7992
238	609595	7	-274	6637	-1447	2574	1882	-410	-784	-119	672	532	549	546	-371	-159	164	-54	52	-61	7992
239	609696	15	-302	6637	-1437	8150	1320	-485	-756	-110	640	519	500	535	-368	-152	178	-58	64	-49	7992
239	609696	14	-322	6637	-1444	8150	1321	-543	-726	-93	623	512	476	525	-370	-152	181	-66	67	-42	7992
239	0	14	-341	6637	-1437	8150	1922	-578	-701	-90	601	492	460	520	-371	-152	184	-74	70	-36	7992
239	0	14	-354	6637	-1435	8150	1940	-617	-647	-83	595	475	446	513	-373	-148	189	-76	72	-37	7992
239	0	14	-387	6637	-1417	8150	1919	-633	-653	-71	589	472	430	530	-374	-153	194	-93	72	-30	7992
239	0	12	-387	6637	-1409	8150	1891	-582	-529	-60	601	471	434	531	-381	-153	195	-95	72	-30	7992

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
1	70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A	70707	0	1	-1	-1	1	4	-2	-3	-3	1	-1	2	-2	0	0	-1	-2	2	0	3
2	101010	-3	-3	6	5	4	4	-3	-1	-3	9	8	16	10	8	-7	-2	-2	7	6	10
2A	101010	1	-1	3	3	3	2	-3	-4	-6	4	7	15	10	6	-7	-7	-5	4	4	8
3	121212	0	-3	12	9	10	5	-3	-4	-7	10	13	30	18	13	-15	-6	-5	11	10	14
3A	121212	0	-4	19	10	11	5	-1	1	-2	16	14	31	20	18	-15	-2	2	17	13	17
4	151515	1	-7	24	19	21	6	-1	1	-2	22	28	48	33	29	-21	1	2	26	25	27
4A	151515	2	-9	27	20	22	10	1	3	0	23	28	51	35	28	-21	1	2	27	22	28
5	171717	1	-12	30	30	31	12	4	6	-1	33	36	68	48	38	-29	6	4	37	31	31
5A	171717	2	-13	34	33	33	12	4	7	2	38	38	68	50	40	-27	7	4	36	36	37
6	202020	4	-15	44	43	51	18	9	16	12	55	51	91	70	58	-35	18	14	56	50	47
6A	202020	2	-17	46	45	51	20	11	16	12	55	52	90	70	58	-37	20	15	53	52	47
7	222222	1	-21	58	55	54	20	12	17	12	63	64	99	87	66	-43	19	15	66	60	54
7A	222222	2	-19	60	54	55	19	11	16	10	65	64	98	85	67	-42	18	13	66	59	53
7B	222222	1	-19	61	57	59	22	13	17	11	63	65	99	89	68	-42	20	15	68	64	54
8	202020	4	-17	52	50	51	20	10	14	10	56	53	84	75	57	-35	18	12	60	54	48
8A	202020	3	-17	53	48	51	20	11	14	8	57	58	83	74	60	-35	17	15	60	54	49
9	151515	3	-9	34	33	38	15	3	9	10	42	39	62	50	42	-20	14	10	40	40	34
9A	151515	2	-10	34	35	38	18	11	10	10	43	38	62	49	42	-19	14	8	37	39	34
10	70707	2	1	12	14	17	12	6	7	10	18	13	7	10	11	2	8	5	10	16	10
10A	70707	2	2	11	13	14	14	7	8	10	18	10	5	9	11	1	8	8	12	16	10
13	70707	17	18	57	66	64	55	44	48	58	63	44	30	47	47	23	56	54	61	66	48
13	70707	17	18	57	59	60	50	44	42	53	58	41	27	44	43	23	50	52	57	62	47
14	101010	17	12	59	66	64	52	39	43	50	63	48	43	54	52	13	51	50	66	66	53
14	101010	16	13	57	65	64	50	39	42	49	63	48	39	53	52	17	48	48	66	64	54
15	121212	15	9	63	70	68	48	39	40	49	69	58	56	64	61	8	49	48	72	70	58
15	121212	17	9	63	67	64	48	38	39	45	66	58	54	63	61	8	45	44	67	67	59
16	151515	17	9	68	73	71	49	37	39	43	73	64	71	75	68	2	46	45	76	74	65
16	151515	16	8	68	70	70	49	37	40	42	75	67	70	76	69	3	46	45	76	74	66
17	171717	17	4	78	79	74	47	34	38	42	81	77	84	84	78	-7	46	46	86	80	73
17	171717	17	4	78	78	74	48	34	37	42	82	74	86	87	80	-4	44	48	86	80	73
18	202020	17	0	88	86	81	48	34	40	38	88	85	101	99	87	-13	48	48	96	87	81
18	202020	16	1	88	86	81	50	36	37	40	91	85	105	100	88	-12	46	45	97	87	80
19	222222	16	-3	98	93	87	48	37	39	36	98	95	120	113	98	-20	46	48	104	94	89
19	222222	16	-3	98	90	85	45	38	38	37	98	94	119	110	97	-20	46	44	105	94	90
20	202020	16	0	89	85	79	45	34	37	33	88	84	104	100	88	-13	42	44	96	87	80
20	202020	16	-1	88	85	77	45	34	36	33	88	85	105	101	88	-11	39	44	95	86	80
21	171717	17	3	79	75	72	42	31	34	33	79	76	90	87	78	-3	39	40	86	79	74
21	171717	15	2	74	75	69	40	31	32	36	80	75	88	84	77	-7	36	39	84	79	75
22	121212	16	10	59	59	52	35	30	27	30	59	55	58	60	57	8	33	35	63	62	58
22	121212	17	10	60	57	51	35	26	26	30	57	55	56	57	53	9	30	34	64	59	57
23	70707	17	17	40	40	34	32	23	24	28	39	36	21	30	35	24	28	30	42	44	38
23	70707	15	17	39	40	34	28	24	22	27	38	34	21	30	33	26	24	28	42	44	38
26	70707	16	13	33	35	24	25	18	17	20	32	28	17	23	31	26	17	24	36	36	34
26	70707	13	16	34	33	25	24	19	15	17	30	29	17	23	30	23	16	24	36	36	34
27	100710	15	18	36	34	26	24	14	14	17	29	29	17	26	29	26	13	22	33	31	32
27	100710	15	17	33	30	27	22	14	14	17	27	27	17	25	26	26	10	17	32	32	30
28	120712	15	17	38	35	29	25	14	14	14	33	33	22	30	30	21	13	17	35	32	34
28	120712	14	16	38	35	30	25	17	16	15	33	34	26	30	33	21	11	19	34	33	32
29	150715	14	17	45	47	32	24	16	15	17	33	41	29	36	37	18	10	18	36	36	35
29	150715	15	13	42	47	30	26	14	13	15	35	38	30	35	36	19	11	14	34	32	35
30	170717	16	13	44	40	34	25	17	14	12	35	43	35	38	38	13	8	14	34	32	37
30	170717	16	13	48	42	33	25	14	17	14	40	45	37	40	39	13	8	15	37	37	33
31	200720	16	18	57	45	41	26	13	20	13	42	51	44	45	43	12	8	15	38	36	35
31	200720	16	13	53	45	34	24	18	14	13	38	48	44	43	42	13	8	14	39	36	37
32	220722	17	18	54	49	42	30	19	17	12	43	55	50	50	47	13	8	14	38	37	37
32	220722	14	13	56	46	40	28	17	17	12	43	55	51	49	46	12	8	14	38	36	35
33	200720	15	13	53	43	40	25	16	16	12	38	51	48	46	43	11	6	15	39	37	36
33	200720	17	16	55	43	37	25	18	16	12	39	48	48	43	45	11	7	15	37	37	36
34	170717	16	17	48	39	33	24	14	15	10	38	45	41	40	38	13	6	14	35	32	35
34	170717	16	16	49	39	32	24	14	14	12	38	45	39	40	37	13	6	13	36	34	33

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
35	150715	16	18	43	34	28	24	14	12	10	33	38	32	36	36	18	6	13	32	30	30
35	150715	16	17	44	36	29	20	12	12	11	33	40	31	37	36	18	8	15	32	33	31
36	120712	16	18	39	32	24	21	10	12	12	30	34	27	30	31	21	-7	13	26	27	29
36	120712	17	19	41	34	27	20	14	12	11	28	35	24	30	33	21	6	13	32	32	28
37	100710	14	18	34	29	23	21	13	7	11	25	28	17	26	28	23	8	14	31	30	27
37	100710	17	18	31	29	23	22	12	12	12	23	28	18	27	30	21	4	14	32	33	29
38	70707	16	23	39	34	37	30	22	20	25	31	29	17	30	29	30	26	30	42	44	30
38	70707	17	22	40	37	34	29	23	23	26	36	29	12	30	30	28	29	30	42	42	32
51	70707	14	16	47	44	47	42	32	33	46	39	29	14	34	35	28	30	45	52	52	39
51	70707	14	18	46	47	47	40	31	34	43	37	29	14	35	37	26	48	45	50	53	35
52	71007	16	15	46	47	44	40	31	34	42	40	32	23	39	40	26	46	45	56	57	40
52	71007	15	15	45	47	44	37	28	31	40	39	32	24	40	40	26	48	45	56	57	43
53	71207	14	13	47	45	44	35	27	25	36	40	34	27	47	41	21	46	44	59	59	49
53	71207	15	13	46	43	43	35	24	24	31	36	32	29	43	41	20	41	42	56	55	44
54	71507	15	11	44	43	43	32	24	20	30	41	32	25	50	43	16	43	43	63	60	50
54	71507	13	10	45	42	40	32	19	21	28	39	35	32	48	42	13	41	42	62	57	48
55	71707	14	6	44	43	37	27	16	16	22	39	36	41	53	46	10	36	39	66	62	51
55	71707	16	6	41	42	37	28	19	15	22	38	35	41	53	46	11	36	37	64	61	50
56	72007	16	7	46	42	34	25	14	16	18	43	39	49	60	51	5	36	35	67	62	59
56	72007	16	6	45	41	37	24	13	15	18	42	40	49	61	53	7	36	35	70	64	60
57	72207	13	2	47	43	35	22	13	14	16	40	43	57	68	53	2	34	35	75	67	66
57	72207	16	3	48	43	37	21	13	12	14	43	40	58	68	53	1	36	35	74	67	64
58	72007	15	3	43	39	32	20	11	14	14	41	39	51	60	52	5	30	32	66	62	57
58	72007	14	6	38	42	33	19	11	9	12	38	39	51	60	50	5	28	32	67	57	57
59	71707	16	10	39	35	28	20	7	7	10	36	34	42	50	43	10	24	31	60	54	50
59	71707	15	9	38	35	29	21	9	12	10	35	33	43	50	42	10	26	31	57	53	50
60	71507	15	12	34	30	26	18	8	7	10	28	29	35	43	37	16	21	27	49	48	44
60	71507	14	8	33	30	24	17	8	6	13	29	31	34	43	38	13	21	25	50	47	44
61	71207	14	13	22	20	14	15	8	4	7	13	16	11	24	23	26	21	25	37	38	33
61	71207	14	13	29	27	19	18	9	8	9	26	24	24	36	32	21	20	24	40	40	40
63	70707	16	20	24	20	14	19	7	6	10	14	13	5	18	20	25	15	20	24	26	24
63	70707	15	20	26	19	14	14	4	7	12	12	18	3	18	20	30	14	22	25	27	25
1A	70707	14	18	15	15	10	14	4	2	2	6	14	0	13	13	31	9	15	17	20	20
2A	101010	16	17	24	20	13	14	5	2	0	12	22	13	23	23	23	8	14	26	27	26
3A	121212	17	12	33	26	18	14	5	3	-1	18	29	29	38	30	17	8	13	33	32	33
4A	151515	15	10	37	32	24	13	3	2	-1	28	38	42	48	41	8	8	12	42	41	40
5A	171717	14	6	46	37	32	15	3	2	-4	35	48	60	61	50	2	9	14	50	46	49
6A	202020	15	7	57	48	40	15	4	4	-4	43	58	79	78	61	-7	11	16	60	54	58
7A	222222	17	0	66	53	44	17	4	4	-4	53	68	94	90	70	-16	11	18	70	63	65
8A	202020	15	4	60	45	39	14	1	2	-5	43	60	81	78	63	-7	8	16	64	56	59
9A	171717	16	11	51	39	33	14	2	4	-5	35	52	66	66	53	2	9	17	60	52	50
10A	151515	14	13	40	34	27	13	1	1	-1	30	39	51	54	43	7	8	12	44	41	40
11A	121212	16	13	33	26	18	10	1	0	-4	22	32	36	40	33	13	4	10	35	36	31
12A	101010	16	10	28	19	14	12	3	1	0	14	25	18	30	25	23	10	14	27	30	24
13A	70707	14	21	22	19	12	15	4	6	8	14	18	4	21	18	30	14	17	25	27	19
76	70707	14	21	37	41	36	32	16	21	30	32	23	12	30	29	38	36	34	46	46	33
77	121212	14	16	48	51	47	33	14	19	25	43	38	42	50	43	22	33	34	60	57	45
77A	151515	14	12	60	55	49	30	17	17	21	51	50	59	65	53	12	31	32	66	63	55
78	171717	16	11	69	59	50	28	13	13	15	55	56	71	75	60	5	28	30	71	67	58
78A	202020	14	7	72	63	54	29	13	17	17	63	65	85	88	69	-3	30	33	81	75	68
79	222222	14	3	83	70	60	30	14	16	15	74	77	103	103	80	-10	28	33	94	82	74
80	252525	16	-1	93	77	66	32	13	15	13	82	88	120	115	91	-17	30	32	99	87	85
80A	292525	16	1	91	75	65	28	13	16	13	83	87	121	117	93	-17	29	32	103	87	83
81	272727	15	-3	98	81	74	29	11	15	9	91	96	138	130	102	-23	27	31	114	95	90
81A	272727	14	-7	103	80	71	26	10	14	8	93	95	139	130	101	-24	26	27	113	96	92
82	303030	17	-10	111	92	91	28	11	15	5	108	113	169	155	106	-27	27	29	130	106	103
82A	303030	15	-10	110	92	81	27	9	15	5	107	108	171	155	103	-27	25	30	131	108	105
83	323232	15	-14	123	99	89	28	9	14	5	122	125	191	175	115	-37	24	30	147	119	117
83A	323232	16	-19	123	98	90	29	9	14	4	123	128	196	178	113	-33	26	28	152	121	115
84	353535	16	-24	146	110	101	28	9	17	3	151	146	230	215	123	-43	29	32	195	146	133
84A	353535	16	-23	146	112	104	28	10	16	4	152	147	239	220	121	-42	28	30	199	146	130

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
84B 353535	14	-26	153	117	107	28	11	14	6	165	155	246	233	122	-40	31	31	214	155	138
84C 353535	16	-26	155	117	107	29	9	16	4	167	154	251	233	121	-40	28	30	218	155	137
85 373737	15	-28	167	125	114	30	11	16	6	187	174	279	268	129	-48	31	34	240	174	148
85A 373737	17	-27	168	125	116	29	11	18	5	186	173	281	270	131	-49	31	32	242	174	149
86 353535	16	-24	160	119	109	28	10	17	6	181	166	270	264	126	-41	30	32	236	170	145
87 323232	15	-22	151	110	104	25	8	12	4	171	155	256	249	111	-33	26	25	225	161	135
88 303030	14	-19	142	105	95	25	8	10	3	161	146	241	235	101	-27	26	27	214	155	128
89 272727	16	-14	133	97	93	24	5	12	7	154	136	224	223	93	-19	24	25	202	146	120
90 252525	15	-11	123	89	82	22	4	9	3	141	125	206	205	81	-11	20	21	187	136	110
91 222222	15	-7	113	80	72	22	4	6	3	132	114	188	188	70	-4	19	20	176	129	102
91A 202020	16	-3	104	73	67	18	3	6	3	122	104	168	170	62	2	16	17	165	119	97
92 171717	16	0	94	63	57	16	0	4	2	113	97	149	154	53	10	16	18	152	106	86
92A 151515	14	5	85	55	49	15	1	3	3	103	81	127	135	42	18	12	17	137	101	78
93 121212	16	10	74	47	42	15	0	2	1	93	73	108	117	31	23	11	15	125	90	67
94 70707	14	16	54	29	23	11	-4	0	3	72	48	64	80	7	40	5	11	97	72	48
95 70707	14	13	71	50	49	35	20	19	33	86	53	88	86	18	46	41	41	117	92	55
95A 121212	14	8	86	62	61	35	19	20	31	101	68	91	115	32	33	41	43	136	106	68
96 171717	12	3	97	75	71	35	18	17	27	116	87	125	145	47	18	40	42	156	121	86
96A 222222	14	-7	120	90	84	37	14	22	24	138	111	168	180	69	2	40	42	180	133	102
97 272727	15	-12	141	105	102	36	22	21	22	157	134	208	214	86	-11	41	43	204	153	119
97A 323232	14	-20	160	121	112	38	18	22	20	182	154	249	250	108	-30	41	44	234	173	138
97B 353535	12	-25	171	129	124	42	17	24	22	196	168	277	274	119	-34	45	43	255	183	146
98 373737	14	-23	185	137	132	37	16	25	18	212	185	298	303	129	-42	44	44	276	199	158
99 373232	14	-22	168	122	117	32	11	16	13	201	168	288	298	118	-42	34	37	257	191	142
100 372727	16	-17	151	104	104	29	9	14	12	182	148	269	282	108	-34	32	33	234	171	122
100A 372727	14	-17	143	106	100	30	7	14	9	181	148	271	283	108	-37	29	32	230	171	124
100B 372727	14	-17	143	100	99	22	1	7	4	178	145	268	279	103	-36	25	25	226	169	120
100C 372727	13	-17	148	99	96	22	-1	6	3	179	147	268	278	103	-35	25	25	227	166	120
101 372222	15	-11	130	85	84	20	1	4	4	160	128	253	265	93	-27	23	25	204	150	99
101A 372222	16	-12	131	86	84	20	-1	4	3	160	128	254	266	98	-29	23	23	203	151	103
102 371717	14	-8	108	68	65	14	-6	-2	0	137	103	233	246	83	-21	15	17	172	124	77
102A 371717	16	-8	104	63	63	13	-7	-3	-2	132	103	231	243	81	-20	13	16	167	124	80
102B 371515	14	-9	97	55	52	8	-9	-6	-7	122	91	220	231	72	-17	8	13	152	112	70
102C 371515	14	-9	97	53	52	10	-8	-8	-8	122	91	223	233	72	-15	8	12	153	113	70
103 371212	14	1	86	47	44	6	-11	-10	-8	110	81	214	225	69	-11	7	10	140	104	60
103A 371212	16	-3	88	47	42	8	-12	-8	-7	112	78	213	223	69	-12	8	12	138	101	60
103B 371010	15	0	78	37	34	5	-13	-12	-8	100	68	206	214	63	-7	1	8	122	90	50
103C 371010	14	4	74	37	34	6	-10	-10	-11	100	67	205	210	63	-7	1	9	120	87	50
104 370707	14	5	71	30	26	4	-15	-14	-10	88	55	196	202	60	-4	0	7	107	80	40
104A 370707	14	4	68	29	25	3	-13	-13	-8	88	56	196	203	60	-4	1	10	106	83	42
105 320707	16	10	68	27	29	5	-14	-13	-8	90	56	179	190	50	2	1	7	111	82	43
106 270707	15	11	68	29	27	4	-13	-13	-9	88	54	158	173	41	10	1	5	110	82	40
107 220707	15	13	65	29	24	4	-16	-13	-8	90	54	138	158	32	13	0	5	111	84	45
108 150707	13	18	67	29	23	5	-12	-8	-7	86	53	104	130	18	26	1	5	114	94	45
109 70707	15	23	67	30	24	7	-13	-11	-7	86	51	72	107	2	33	3	7	119	87	45
114A 70707	10	23	107	70	71	40	18	22	39	132	81	94	130	27	58	41	48	174	135	74
115 120712	12	21	115	78	74	42	18	22	35	135	94	109	141	31	52	38	45	174	134	78
116 170717	12	21	125	92	76	40	17	20	30	141	98	122	154	35	43	31	40	172	134	76
117 220722	12	19	136	99	84	39	14	19	27	147	108	140	167	42	40	25	35	177	133	80
118 250725	12	20	138	90	87	41	13	17	26	152	116	151	173	44	33	21	32	175	135	80
119 270727	9	19	143	91	90	39	13	19	21	155	122	161	179	48	31	18	29	175	134	79
120 300730	10	18	148	97	94	37	11	16	18	158	128	169	185	50	29	11	25	176	131	80
121 320732	13	16	154	99	96	39	13	15	17	162	137	179	193	53	27	9	24	178	132	80
122 350735	12	18	158	103	101	35	10	15	14	165	141	190	200	58	25	6	19	176	133	87
123 370737	11	16	165	102	101	34	7	11	10	167	145	193	207	58	20	1	15	179	131	86
123A 400740	14	17	169	105	102	36	6	14	10	170	154	201	212	61	17	-4	12	182	133	89
123B 370737	13	18	165	100	100	33	3	9	4	167	148	193	209	53	18	-4	9	177	132	85
123C 370737	12	18	158	94	88	25	-3	1	-7	161	145	191	203	51	19	-18	-1	166	123	80
124 350735	12	20	152	87	84	24	-6	-3	-8	157	142	183	197	46	23	-18	1	167	120	78
125 320732	14	25	146	82	79	20	-7	-3	-8	154	136	176	193	41	28	-19	0	165	118	78
126 300730	9	19	141	75	73	16	-7	-6	-9	149	128	164	185	37	28	-19	0	160	112	75

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
127 270727	12	25	133	70	67	15	-11	-6	-12	142	125	156	175	31	33	-22	0	156	114	95
128 250725	12	26	125	65	60	12	-11	-10	-15	136	116	148	169	26	33	-20	-4	145	110	68
129 220722	10	26	115	57	52	7	-16	-16	-17	130	108	138	158	19	38	-25	-6	142	104	60
130 170717	16	29	102	47	41	4	-19	-18	-18	120	96	121	144	13	45	-27	-5	141	100	59
131 120712	12	30	87	34	31	-1	-21	-23	-22	110	85	103	129	4	53	-26	-8	133	95	55
132 70707	13	30	72	22	22	-5	-24	-26	-26	100	72	81	115	-2	55	-26	-7	126	89	48
133 70707	13	33	71	20	21	5	-19	-18	-14	83	56	60	107	-11	64	-7	8	124	93	39
134 71207	14	28	74	25	24	3	-21	-18	-15	94	64	78	120	0	55	-3	11	144	103	50
135 71707	12	21	83	30	29	4	-23	-20	-18	103	71	100	140	7	46	-1	9	159	115	60
136 72207	15	13	89	37	34	0	-21	-23	-18	117	81	125	163	21	39	1	18	181	130	77
137 72507	14	11	90	40	38	0	-24	-22	-22	123	85	136	174	27	33	1	15	189	140	84
137A 202520	14	7	122	61	59	4	-19	-15	-18	147	116	179	210	43	20	0	14	207	150	97
138 202720	14	6	123	62	64	5	-19	-18	-22	155	124	189	224	51	13	0	15	221	161	103
139 203020	10	4	125	69	66	5	-22	-20	-23	165	126	204	234	55	10	1	15	233	167	109
140 203220	15	-1	135	72	69	4	-21	-19	-23	171	134	216	246	63	6	1	15	247	176	119
141 203520	14	-4	136	73	71	5	-20	-20	-24	179	137	231	259	73	2	4	15	266	194	126
142 203720	16	-4	141	79	76	5	-21	-18	-25	186	145	244	273	76	-3	6	18	284	220	135
142A 173717	12	-9	142	77	73	-2	-26	-23	-28	190	142	244	278	73	-5	-3	14	294	244	139
142B 153715	12	-7	137	69	71	-5	-28	-25	-30	182	136	238	273	72	-1	-1	12	293	242	138
142C 153715	12	-5	132	65	66	-5	-28	-29	-33	179	131	231	269	68	4	-4	12	293	243	135
143 153515	14	0	128	62	63	-5	-27	-26	-32	176	128	222	260	61	7	-7	11	284	235	130
144 153215	13	1	126	57	61	-5	-27	-26	-30	170	121	211	252	57	13	-6	9	276	231	120
145 153015	16	7	123	57	57	-2	-27	-26	-30	164	118	204	242	52	18	-6	10	265	224	118
146 152715	16	9	118	53	54	-5	-27	-26	-30	157	115	193	229	44	21	-12	5	253	215	109
147 152515	17	12	113	47	51	-5	-29	-25	-30	151	106	183	217	40	21	-16	3	241	205	100
147A 72507	14	14	92	30	34	-8	-34	-33	-33	131	88	151	196	28	35	-16	4	227	196	93
148 72207	16	18	88	27	32	-8	-33	-33	-36	126	83	141	182	21	41	-19	2	218	186	88
149 71707	16	23	82	18	22	-11	-37	-33	-34	114	71	119	157	6	50	-24	-5	194	171	70
150 71207	14	29	76	10	16	-9	-36	-33	-36	102	63	94	135	-7	60	-30	-7	171	153	57
151 70707	16	36	68	5	12	-12	-36	-34	-34	90	53	68	109	-19	68	-33	-12	147	133	40
152 70707	16	38	73	0	12	-10	-36	-31	-32	90	48	60	102	-23	75	-32	-10	153	149	33
152A 120000	15	31	104	17	24	-10	-36	-32	-33	112	73	96	140	-7	61	-31	-7	178	165	53
153 170000	16	26	112	30	44	-5	-32	-28	-34	135	94	142	178	13	48	-27	-5	203	190	70
153A 220000	16	17	132	49	60	-3	-31	-28	-33	159	118	184	217	31	32	-23	-3	236	215	88
154 270000	16	12	153	66	74	2	-28	-23	-30	185	143	222	259	53	17	-19	4	269	244	107
154A 300000	16	8	164	79	93	4	-27	-17	-25	210	160	251	290	68	10	-10	7	299	266	123
154B 320000	16	1	183	85	100	8	-23	-17	-27	226	183	268	307	72	3	-9	8	317	286	130
154C 350000	17	-1	201	103	116	10	-21	-14	-21	265	230	311	350	81	-1	-5	12	351	331	153
155 370000	17	-4	219	113	132	12	-19	-11	-19	292	272	346	399	90	-3	-2	14	383	364	172
156 400000	17	-17	246	125	150	15	-17	-8	-17	330	313	366	457	102	-9	4	19	420	411	202
156A 400000	17	-21	276	130	172	19	-13	-6	-10	382	361	371	486	113	-11	6	22	457	464	240
157 420000	17	-22	295	140	188	19	-16	-4	-11	406	385	390	510	126	-17	6	20	483	490	257
158 450000	17	-22	487	563	442	30	-11	6	10	830	768	671	757	638	-67	26	60	635	615	366
158 450000	16	-20	502	585	457	33	-9	7	12	845	773	684	770	665	-67	26	60	646	626	379
158 450000	15	-21	508	591	463	30	-11	7	11	852	778	687	780	677	-68	26	60	653	635	385
159 420000	17	-17	498	580	453	29	-11	6	10	836	768	669	767	671	-57	24	58	636	625	377
160 400000	17	-15	486	570	445	28	-13	3	10	822	756	651	750	661	-49	21	58	625	614	370
161 370000	16	-13	476	557	432	25	-17	2	10	802	741	625	730	650	-42	18	55	611	604	359
161A 370000	17	-12	473	558	432	25	-13	2	6	807	746	623	729	650	-41	17	55	610	603	359
161B 370000	16	-14	485	567	445	30	-12	5	13	819	751	631	736	653	-37	21	59	623	614	369
161C 370000	15	-18	513	602	471	35	-4	18	28	845	773	655	755	673	-37	38	70	648	636	396
161D 370000	13	-18	516	607	470	33	-8	7	21	847	783	653	754	670	-32	26	60	649	636	400
161E 370000	14	-18	516	609	472	32	-8	7	22	846	782	655	758	671	-30	24	59	651	636	399
162 350000	16	-11	506	597	461	32	-8	6	20	831	768	640	748	663	-20	24	60	636	626	393
163 320000	14	-10	493	580	449	27	-11	6	15	812	752	620	729	652	-14	18	54	619	616	382
164 270000	15	-2	468	554	424	25	-13	1	16	777	722	576	696	633	0	15	52	589	596	366
165 220000	14	5	440	524	398	19	-17	-4	10	735	687	527	652	609	13	7	45	559	566	344
166 170000	16	15	414	490	370	18	-19	-6	8	693	651	468	605	583	32	3	42	529	543	320
167 120000	17	26	386	463	342	12	-22	-12	7	651	618	410	557	560	47	-2	37	497	516	295
168 70000	14	33	355	433	314	7	-24	-16	8	609	578	349	500	528	62	-9	32	461	488	271
169 120000	13	25	376	466	337	10	-21	-13	3	642	611	391	537	547	48	-4	35	494	509	291

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		CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
169A	120000	13	25	371	466	334	14	-20	-11	3	641	610	386	538	542	47	-3	39	494	510	290
170	170000	16	19	397	497	361	18	-13	-7	8	680	647	439	583	567	33	-2	40	529	536	313
171	220000	15	10	427	530	389	22	-17	-4	12	722	688	491	630	593	21	6	43	567	566	334
171A	220000	16	8	443	549	404	25	-9	4	20	742	706	508	638	607	26	15	53	586	582	349
172	252222	14	7	445	547	404	26	-8	2	16	741	705	524	649	609	22	11	51	586	581	350
172	272222	14	5	445	547	404	25	-9	-1	13	741	706	524	649	610	23	11	48	582	578	350
173	302222	15	6	443	545	403	24	-13	-3	13	740	705	535	655	612	20	7	45	584	574	349
174	322222	14	5	443	546	397	22	-16	-6	11	740	707	548	663	616	15	5	44	578	573	347
175	352222	16	3	445	543	406	14	-19	-10	2	741	708	561	670	623	13	0	39	576	572	347
176	372222	14	1	444	543	408	0	-21	-13	0	742	706	571	680	632	9	-2	38	574	566	346
177	392222	14	1	442	542	411	15	-16	-11	4	749	716	587	697	649	5	0	42	579	573	346
178	422222	16	3	444	540	411	15	-19	-10	3	751	716	576	692	645	10	1	43	580	573	347
179	402222	14	2	446	544	403	12	-20	-11	1	748	714	566	685	644	11	-1	40	577	572	345
180	272222	15	4	444	540	401	12	-22	-14	-3	742	708	551	674	637	13	-8	40	575	568	342
181	252222	15	3	435	539	399	11	-21	-14	-2	739	708	543	664	630	20	-9	35	573	565	343
182	222225	15	10	436	537	394	9	-24	-16	-7	736	708	530	655	627	23	-10	33	571	566	341
183	222222	16	9	435	533	393	8	-24	-18	-8	736	707	518	648	621	26	-10	31	570	565	340
183A	252222	14	12	428	527	386	2	-27	-23	-14	730	701	511	642	618	26	-19	25	562	560	330
184	250000	16	7	433	530	394	4	-27	-23	-14	749	723	531	660	625	20	-15	29	581	573	347
185	270000	14	1	453	552	410	4	-27	-20	-12	768	737	556	681	633	11	-13	28	593	586	357
186	300000	16	-1	463	568	420	5	-27	-22	-16	787	757	576	702	643	3	-15	30	610	598	369
187	320000	17	-7	480	587	437	10	-26	-19	-12	809	777	603	725	657	-2	-9	33	631	616	382
188	350000	15	-9	476	587	443	10	-26	-16	-12	831	801	634	746	673	-10	-9	35	651	634	395
189	370000	14	-14	502	610	468	11	-26	-16	-14	856	826	660	769	700	-18	-10	32	671	653	408
189A	370000	16	-11	521	644	491	12	-23	-13	-8	877	839	670	779	713	-19	-6	32	684	671	417
189B	370000	14	-20	566	694	533	51	13	30	46	911	857	695	815	751	-21	53	84	730	716	450
189C	370000	12	-24	569	694	532	53	12	30	46	911	856	699	816	759	-22	55	84	726	713	456
189D	370000	11	-24	577	700	544	54	14	32	50	918	864	707	823	765	-20	58	93	736	721	463
189E	370000	13	-26	573	731	566	65	23	44	66	950	894	729	845	783	-17	70	102	756	744	483
189F	370000	12	-28	573	730	566	65	21	42	66	951	896	725	840	786	-17	69	103	755	744	480
189G	370000	10	-27	601	737	567	58	17	34	56	954	896	731	850	793	-12	58	92	759	746	488
189H	370000	13	-27	601	735	564	55	17	34	53	955	897	734	850	792	-15	58	92	756	746	488
189Q	370000	12	-29	604	744	572	60	18	36	60	960	902	739	857	801	-14	59	94	766	753	494
189R	370000	11	-28	611	746	579	62	19	35	56	962	908	746	864	802	-12	58	92	766	757	498
190	400000	12	-32	625	765	591	62	19	38	62	987	932	771	894	830	-19	61	96	784	775	511
191	420000	9	-37	643	746	610	60	19	37	60	1007	955	801	923	852	-27	59	96	805	796	530
192	450000	9	-41	664	803	626	60	19	38	55	1032	981	831	960	896	-33	58	94	825	823	552
193	470000	9	-49	693	837	649	62	17	42	59	1062	1012	870	995	933	-42	60	97	851	866	575
194	470000	11	-47	692	838	650	62	17	42	63	1064	1015	871	995	938	-43	59	99	853	871	577
194	500000	10	-53	717	869	671	64	21	40	62	1093	1044	902	1032	981	-49	61	99	876	905	607
194	500000	12	-53	716	869	673	64	19	39	62	1098	1046	918	1035	987	-48	61	98	876	906	612
195	300000	11	-24	605	745	562	47	3	22	49	935	894	718	870	890	12	38	79	730	796	523
196	400000	12	-37	663	805	614	53	13	29	51	1017	973	816	957	936	-17	46	83	804	851	573
197	450000	12	-47	693	833	643	54	14	32	52	1066	1016	869	997	959	-34	51	88	843	881	599
198	500000	12	-56	737	887	681	61	17	36	58	1110	1067	931	1050	1015	-47	57	94	895	924	632
199	520000	12	-60	765	923	710	64	19	40	59	1148	1098	974	1073	1057	-55	56	97	917	965	664
199	520000	12	-62	778	935	726	60	14	39	59	1150	1098	985	1083	1070	-53	53	95	888	996	677
200	550000	11	-59	806	969	756	65	15	38	61	1182	1127	1041	1100	1116	-67	58	100	926	1037	704
200	550000	11	-69	814	978	768	64	16	41	63	1182	1127	1081	1108	1147	-67	61	102	933	1052	720
200	550000	12	-73	825	987	774	65	17	39	63	1187	1138	1263	1109	1182	-71	61	102	940	1064	738
200A	550000	12	-73	950	1102	764	63	14	40	63	1182	1143	1273	1107	1209	-69	60	101	926	1076	745
200A	550000	12	-72	1025	1079	797	64	16	40	63	1191	1168	1274	1107	1263	-68	56	97	925	1104	770
200A	550000	12	-86	1074	1116	914	93	32	54	78	1230	1244	1290	1118	1305	-61	57	101	936	1109	794
200A	550000	10	-85	1080	1113	974	64	44	57	85	1308	1255	1290	1185	1323	-57	72	95	1016	1256	805
200A	550000	11	-85	1083	1122	976	63	53	57	83	1302	1257	1291	1185	1321	-57	76	98	1024	1262	812
200B	550000	12	-87	1091	1133	988	63	41	56	82	1312	1268	1301	1185	1345	-60	72	94	1016	1262	816
201	600000	10	-61	977	1027	896	52	33	42	76	1142	1135	1131	1045	1262	-15	61	88	896	1156	750
202	200000	12	-17	777	947	712	35	21	26	66	972	917	846	773	1000	47	40	69	996	971	637
202A	200000	10	-24	786	830	720	54	36	42	86	972	900	921	750	977	50	64	90	919	966	635
203	300000	12	-41	843	918	731	61	41	47	92	1066	988	946	850	1045	21	74	94	772	1039	684
204	400000	11	-59	943	1014	885	67	49	57	98	1174	1105	1096	989	1202	-8	85	107	870	1133	747

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 81	CHAN 82	CHAN 83	CHAN 84	CHAN 85	CHAN 86	CHAN 87	CHAN 88	CHAN 89	CHAN 90	CHAN 91	CHAN 92	CHAN 93	CHAN 94	CHAN 95	CHAN 96	CHAN 97	CHAN 98	CHAN 99	CHAN 100
205	500000	10	-77	1048	1114	980	75	54	63	101	1282	1227	1252	1130	1322	-36	95	113	973	1226	810
206	520000	10	-81	1077	1149	1006	75	54	67	103	1312	1262	1299	1170	1363	-44	95	111	996	1259	828
207	550000	12	-87	1114	1175	1036	77	57	67	105	1345	1303	1351	1209	1410	-49	99	116	1026	1290	851
208	570000	12	-93	1212	1218	1084	75	63	63	111	1410	1375	1418	1226	1448	-50	107	118	1065	1326	885
208	570000	12	-93	1255	1224	1096	79	67	64	112	1416	1379	1428	1226	1449	-50	107	120	1056	1336	893
208	570000	13	-93	1274	1223	1101	76	66	65	113	1419	1387	1430	1230	1445	-48	108	120	1056	1341	898
209	570000	11	-59	1101	1076	943	64	49	46	102	1226	1184	1184	1018	1296	10	87	104	876	1183	803
209	570000	12	-60	1101	1072	942	62	47	47	100	1225	1181	1180	1014	1289	15	88	104	875	1182	800
210	500000	12	-81	1211	1166	1034	72	57	56	110	1341	1304	1338	1144	1380	-21	99	114	983	1272	865
211	550000	4	-97	1267	1209	1083	75	60	57	111	1390	1358	1407	1205	1423	-36	103	114	1030	1317	895
212	570000	12	-97	1290	1236	1090	78	59	64	113	1410	1392	1450	1244	1463	-41	105	120	1053	1343	909
213	600000	14	-125	1553	1301	1124	75	59	59	112	1431	1455	1486	1460	1485	-38	116	120	1180	1704	957
213	600000	11	-127	1575	1312	1144	72	59	60	110	1446	1464	1486	1468	1483	-37	122	120	1181	1722	966
213	600000	14	-127	1578	1316	1144	74	62	60	112	1442	1467	1496	1468	1480	-37	120	121	1181	1725	970
213	600000	13	-129	1586	1319	1149	73	62	62	113	1447	1468	1490	1474	1480	-35	125	123	1186	1735	975
214	620000	10	-142	1629	1537	1294	74	65	55	96	1482	1625	1524	1566	1533	3	126	119	1241	1831	1297
214	620000	14	-141	1645	1544	1302	68	66	49	91	1492	1626	1541	1561	1532	7	128	114	1246	1832	1307
215	650000	12	-140	1787	1677	1407	72	72	58	88	1635	1771	1809	1685	1600	-11	163	122	1366	1875	1428
215	650000	12	-141	1793	1684	1414	74	73	57	86	1640	1776	1815	1692	1595	-11	169	119	1374	1879	1439
216	670000	11	-163	1823	1744	1564	76	79	81	177	1827	2045	2041	1864	1721	-43	255	134	1784	1906	1731
216	670000	10	-161	1844	1696	1574	75	80	83	184	1839	2067	1889	1896	1719	-45	290	137	1506	1912	1750
216	670000	12	-168	1843	1741	1579	75	81	86	187	1840	2077	1889	1929	1722	-45	317	138	1521	1916	1780
217	700000	12	-181	1975	1855	1669	76	92	101	245	1942	2255	2025	2061	1783	-60	438	147	1605	1936	1891
217	700000	12	-186	1977	1442	1681	76	93	106	264	1975	2267	2019	2088	1863	-69	477	154	1624	1938	1918
218	720000	12	-204	1990	1869	1957	81	92	116	327	2045	2558	2045	2059	2018	-87	688	178	1858	2058	2042
219	750000	12	-224	1990	2004	1954	92	91	119	384	2052	2756	2060	2018	2070	-99	735	199	1929	1976	1958
219	750000	10	-224	1956	2007	1994	101	98	121	412	2056	2820	2068	2012	2083	-97	780	217	1965	1976	1958
220	770000	11	-245	1984	2037	2172	144	123	123	580	2055	2659	2086	1988	2089	-109	930	267	1963	2002	1971
220	770000	9	-257	1887	2038	2200	167	129	119	614	2051	2668	2097	1975	2080	-118	983	339	1971	1994	1977
221	400000	12	-166	1026	1358	1521	104	136	124	604	1352	1755	924	627	1059	-5	880	419	1303	1180	1265
222	600000	10	-214	1498	1844	2071	148	186	176	626	1709	2168	1518	1313	1557	-66	955	461	1611	1613	1617
223	750000	11	-266	1988	2059	2141	229	162	146	672	1986	2631	2108	1900	2033	-107	1038	533	1991	2034	2004
224	770000	9	-283	1858	2113	2214	339	172	150	705	2032	2636	2145	1918	2091	-119	1058	562	2019	2030	2020
225	800000	10	-297	1870	2124	2237	370	186	152	772	2025	2634	2360	1935	2119	-135	1099	729	2048	2085	2049
226	820000	6	-326	1904	2129	2259	398	191	162	842	2087	2623	8051	1970	2144	-155	1133	1006	2031	2084	2054
226	820000	6	-339	1901	2135	2267	312	190	174	864	2066	2605	8051	1965	2138	-157	1150	1140	2055	2081	2055
226	820000	6	-343	1898	2125	2244	314	187	173	862	1944	2585	8051	1949	2126	-155	1159	1161	2058	2058	2042
226	820000	6	-354	1898	2134	2251	317	189	174	869	1962	2600	8051	1960	2133	-157	1165	1192	2066	2033	2053
227	850000	4	-403	1897	2138	2237	314	196	207	948	1959	2540	8051	2008	2148	-182	1200	1403	2084	2021	2046
227	850000	6	-371	1743	2008	2104	306	191	203	926	1860	2373	8051	4899	2222	-181	1178	1373	2002	1918	1931
227	850000	1	-373	1535	1869	1973	296	181	189	902	1733	2178	8051	7990	2271	-154	1156	1344	1878	1787	1789
227	850000	0	-360	1373	1742	1842	289	173	183	879	1607	2006	8051	7990	2260	-128	1130	1312	1746	1676	1644
228	550000	-2	-343	1222	1669	1714	280	161	179	852	1487	1847	8051	7990	1779	-67	1103	1300	1629	1481	1508
228	550000	-6	-342	1017	1473	1588	269	147	165	824	1360	1708	8051	7990	672	-32	1071	1267	1483	1311	1355
229	540000	-8	-338	977	1436	1552	264	143	161	810	1326	1668	8051	7990	-629	-20	1056	1259	1462	1270	1323
229A	540000	-4	-334	973	1435	1554	264	143	160	812	1325	1673	8051	7990	-656	-18	1060	1260	1461	1273	1325
230	600000	17	-343	1067	1483	1608	267	150	166	808	1417	1758	8051	7990	-193	21	1094	1292	1616	1430	1456
231	650000	17	-357	1147	1552	1672	272	156	170	802	1558	1932	8051	7990	153	43	1176	1353	1828	1563	1629
232	710000	20	-367	1345	1646	1764	274	165	174	800	1682	2131	8051	7990	291	61	1245	1474	1987	1814	1785
233	608282	17	-382	1555	1754	1850	289	180	196	812	1896	2368	8051	7990	391	30	1354	1843	2075	1942	2007
234	608585	18	-388	1565	1775	1862	284	203	186	817	1922	2381	8051	7990	421	20	1406	1952	2082	1969	2000
235	608787	17	-386	1627	1857	1951	275	208	185	828	1951	2435	8051	7990	466	12	1469	2124	2071	2110	2016
236	609030	17	-390	1307	1954	2092	274	216	192	876	1592	2496	8051	7990	537	8	1553	2316	2166	2102	2032
237	609292	12	-416	1863	2032	2259	274	203	183	900	1952	2603	8051	7990	597	-1	1693	2226	2266	2018	2058
238	609595	15	-471	1973	2114	2301	249	213	196	967	1982	3296	8051	7990	701	-4	1823	2256	2388	2886	2045
239	609696	15	-476	1973	2129	2304	243	223	202	969	1995	4438	8051	7990	723	-7	1842	2237	2655	2926	2049
239	609696	7	-476	1898	2134	2301	241	230	195	947	2000	8028	8051	7990	736	-12	1859	2224	2966	3095	2037
239	0	10	-483	1973	2147	2302	236	243	199	942	2010	8028	8051	7990	753	-10	1864	2218	3453	3137	2043
239	0	14	-491	9028	2135	2279	248	268	204	942	2016	9028	8051	7990	768	-7	1870	2218	3870	3197	2059
239	0	14	-491	9028	2137	2257	241	301	204	922	1994	8028	8051	7990	809	-4	1910	2217	4281	3423	2067
239	0	17	-492	9028	2139	2259	243	373	206	920	1976	8028	8051	7990	843	0	1936	2220	4330	3509	2072

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
1	70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A	70707	1	-3	-1	0	0	0	0	-2	0	0	0	-1	0	0	-2	-2	0	1	1	2
2	101010	0	7	4	10	15	-4	7	-3	11	9	10	6	-4	9	-6	12	-7	11	-6	3
2A	101010	0	4	0	5	11	-6	5	-4	6	6	8	1	-2	7	-5	13	-9	10	-6	3
3	121212	-2	12	2	14	20	-9	12	-9	18	16	18	7	-3	15	-10	25	-16	5	-10	1
3A	121212	1	12	6	18	22	-10	15	-9	23	22	20	7	-3	17	-11	26	-14	22	-15	0
4	151515	2	23	14	29	33	-13	23	-11	38	35	33	17	-6	27	-16	38	-21	35	-20	3
4A	151515	1	27	15	30	35	-14	23	-12	38	36	34	19	-4	25	-15	40	-21	36	-20	2
5	171717	0	37	20	40	46	-21	29	-17	53	48	47	26	-9	34	-21	50	-32	47	-29	1
5A	171717	0	42	22	40	46	-21	30	-20	55	49	47	24	-8	35	-19	51	-32	50	-28	1
6	202020	1	55	35	55	64	-28	43	-20	78	73	66	36	-9	49	-26	67	-40	63	-37	4
6A	202020	1	57	31	55	63	-28	39	-21	81	74	65	37	-12	50	-28	67	-40	66	-36	3
7	222222	1	65	39	64	77	-33	50	-24	95	75	77	42	-16	60	-31	84	-47	76	-43	4
7A	222222	3	63	39	64	78	-33	49	-26	97	69	80	43	-15	60	-34	86	-47	82	-43	4
7B	222222	3	67	43	65	80	-31	52	-24	93	69	81	46	-13	61	-33	86	-48	81	-42	4
8	202020	1	57	37	56	67	-28	43	-20	82	58	70	39	-12	50	-26	73	-41	69	-36	1
8A	202020	3	56	38	55	66	-28	44	-20	81	58	68	38	-12	53	-29	74	-40	69	-33	3
9	151515	3	39	28	36	47	-18	32	-13	57	36	45	27	-5	35	-17	50	-23	47	-18	3
9A	151515	1	38	28	38	46	-18	31	-16	56	34	45	28	-7	37	-17	48	-23	47	-18	4
10	70707	4	15	13	10	14	0	12	1	15	-1	9	10	0	9	-1	10	0	12	3	4
10A	70707	3	11	12	10	15	0	10	-1	17	-3	9	11	3	10	-1	10	0	12	2	2
13	70707	17	62	56	45	45	22	40	18	58	38	45	40	17	38	18	41	17	43	28	32
13	70707	15	48	52	40	42	22	39	20	55	34	43	38	17	36	19	40	18	44	27	33
14	101010	15	57	54	50	51	17	44	16	68	43	54	43	15	46	14	51	10	53	19	31
14	101010	15	58	55	50	52	18	45	14	63	44	52	43	16	45	16	51	4	52	21	33
15	121212	17	65	58	57	60	10	49	11	77	54	64	49	11	50	10	63	0	63	12	34
15	121212	15	69	56	57	60	12	52	10	75	49	63	47	14	50	8	61	0	62	12	34
16	151515	15	67	58	65	70	4	56	6	85	61	72	54	11	59	4	75	-10	74	3	33
16	151515	17	67	59	65	70	6	56	7	84	59	73	52	16	60	4	73	-8	74	5	34
17	171717	15	72	61	75	80	0	60	2	95	69	81	57	8	67	-1	86	-15	85	1	33
17	171717	16	74	64	73	80	-1	60	2	97	68	84	57	9	67	-1	87	-14	86	-3	34
18	202020	17	81	67	81	91	-5	67	-3	106	78	94	60	7	64	-4	98	-22	96	-11	34
18	202020	18	81	65	82	90	-5	68	-2	107	81	94	66	7	75	-6	100	-23	96	-10	34
19	222222	16	90	69	90	102	-11	73	-9	121	92	104	67	5	82	-10	112	-30	109	-18	32
19	222222	16	90	71	91	104	-12	74	-6	122	92	105	71	3	84	-9	114	-31	111	-18	36
20	202020	17	82	64	83	95	-5	67	-4	107	80	92	64	6	75	-9	100	-23	98	-11	36
20	202020	16	79	62	83	94	-4	67	-1	105	79	93	62	6	75	-6	100	-21	96	-12	34
21	171717	17	71	58	72	83	0	62	4	95	66	81	57	8	67	1	86	-14	85	-2	38
21	171717	15	71	56	72	80	-1	62	3	93	68	80	54	10	67	1	87	-14	84	-3	34
22	121212	17	52	44	51	60	14	48	10	65	39	55	42	17	50	11	61	3	60	12	36
22	121212	17	49	41	50	58	13	46	10	63	37	54	42	15	46	11	61	0	60	11	34
23	70707	15	29	32	30	37	25	31	18	36	14	29	29	23	30	21	34	19	36	27	36
23	70707	18	29	34	30	34	22	34	20	35	13	29	29	23	30	24	33	20	36	27	37
26	70707	17	21	22	24	31	25	28	20	27	4	22	26	22	27	25	29	20	27	28	34
26	70707	16	22	19	24	31	22	28	20	23	4	23	24	21	23	25	29	20	27	26	34
27	100710	15	19	17	22	30	22	28	20	28	9	29	24	18	28	21	36	15	37	23	34
27	100710	17	16	16	21	30	22	26	19	28	8	31	22	18	28	21	34	16	35	23	32
28	120712	15	21	17	22	35	20	29	20	37	16	35	31	18	35	15	43	10	42	14	33
28	120712	16	21	17	24	36	20	31	16	38	18	37	29	16	36	18	46	10	46	17	34
29	150715	15	22	18	24	40	18	32	16	47	26	45	34	16	39	11	54	6	52	14	34
29	150715	15	21	16	24	40	17	32	15	47	24	43	32	14	40	13	54	4	52	10	34
30	170717	16	21	16	24	42	17	37	16	57	33	51	37	14	45	8	61	-2	60	7	33
30	170717	17	20	18	24	45	15	36	15	58	36	54	38	12	45	10	62	0	61	5	34
31	200720	16	22	19	27	51	16	38	15	66	43	65	44	13	56	8	77	-5	71	4	34
31	200720	17	23	18	28	50	13	37	14	67	42	64	42	11	56	7	74	-5	70	1	34
32	220722	17	22	22	25	52	11	42	14	77	51	71	46	8	59	4	84	-11	76	-7	34
32	220722	16	22	19	25	57	15	41	14	78	49	71	46	7	59	3	81	-10	76	-5	34
33	200720	18	24	21	27	52	12	39	15	71	42	64	44	10	53	7	75	-6	73	1	34
33	200720	17	25	19	25	50	12	41	13	68	44	63	44	12	55	6	76	-5	68	-1	34
34	170717	15	23	18	24	46	16	37	14	59	34	55	37	15	47	9	65	-1	61	6	34
34	170717	17	24	18	23	47	12	38	13	58	34	54	39	14	48	11	65	0	61	7	34

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
35	150715	15	19	16	22	40	16	34	14	49	24	45	34	16	40	16	54	8	53	11	33
35	150715	17	21	16	24	43	17	35	14	49	26	47	35	16	42	15	56	8	54	12	32
36	120712	17	17	16	21	37	16	29	16	38	16	38	30	21	36	20	46	13	44	19	32
36	120712	17	19	14	22	38	19	32	16	37	14	39	27	20	35	20	44	13	44	19	34
37	100710	17	17	16	19	31	19	27	14	28	7	30	23	22	30	22	42	13	34	22	31
37	100710	18	19	14	18	33	20	26	16	29	6	30	26	23	29	24	32	18	37	21	34
38	70707	18	30	34	23	30	21	29	14	33	11	35	26	25	27	31	26	30	31	33	31
38	70707	17	28	30	22	30	21	29	13	32	12	35	27	27	27	29	26	29	29	34	30
51	70707	11	37	38	23	33	20	28	5	45	19	42	29	28	25	31	27	35	32	40	32
51	70707	14	37	38	23	30	18	29	8	43	19	40	32	24	28	33	24	34	27	39	30
52	71007	13	37	42	30	36	17	33	4	46	24	43	32	26	27	31	30	34	34	36	30
52	71007	14	38	39	30	36	16	31	4	48	22	43	29	25	27	31	28	44	34	37	33
53	71207	15	41	41	32	39	12	34	0	43	18	42	27	25	27	31	28	30	34	34	31
53	71207	15	41	40	32	40	12	34	0	38	16	42	30	27	27	29	29	30	33	34	30
54	71507	14	45	39	39	40	12	36	0	41	15	40	27	25	25	31	30	28	34	34	32
54	71507	17	43	40	40	42	10	38	-2	42	15	41	27	26	25	31	30	28	34	32	33
55	71707	15	48	39	45	48	7	39	-5	38	14	41	27	24	25	28	33	25	36	31	32
55	71707	15	46	38	44	45	2	41	-6	38	14	39	27	25	25	28	30	25	35	30	34
56	72007	15	51	44	52	53	1	41	-9	41	16	43	30	27	29	29	35	24	40	29	34
56	72007	15	52	42	53	54	2	45	-10	38	15	42	27	25	30	26	36	23	40	27	33
57	72207	17	59	44	57	59	-6	48	-14	38	16	44	27	23	29	28	36	20	40	29	34
57	72207	14	59	45	52	60	-4	48	-14	38	18	43	27	26	30	29	34	21	41	26	34
58	72007	15	51	42	52	54	2	43	-9	37	14	39	26	26	27	29	34	22	40	30	34
58	72007	14	51	41	50	52	5	44	-9	37	11	40	26	27	27	28	33	20	40	29	34
59	71707	15	52	34	41	46	5	38	-4	32	11	35	24	27	27	29	28	26	37	32	34
59	71707	15	42	33	41	46	5	37	-4	30	9	35	24	26	24	30	31	25	35	30	36
60	71507	15	35	33	32	39	10	27	-1	25	4	33	22	26	23	31	25	29	32	32	35
60	71507	13	39	28	35	38	10	34	-2	27	5	32	24	28	22	31	26	27	32	33	34
61	71207	15	24	21	24	20	19	24	3	-2	-20	10	12	31	7	39	4	43	10	45	38
61	71207	15	25	23	29	32	15	28	1	23	-12	25	17	27	19	31	24	30	26	37	39
63	70707	14	12	14	10	20	20	19	10	15	-4	24	17	28	13	36	18	36	20	39	37
63	70707	17	12	14	9	20	22	19	10	13	-6	21	16	28	12	36	16	38	20	39	36
1A	70707	15	7	6	5	14	21	13	8	9	-11	19	12	28	10	37	16	39	17	40	38
2A	101010	15	12	8	14	24	17	22	3	17	-4	25	16	28	17	34	25	31	24	34	34
3A	121212	17	20	14	22	34	10	29	1	29	-8	39	22	23	23	29	41	23	37	24	37
4A	151515	15	27	18	29	47	6	36	-4	40	18	49	27	21	34	23	52	15	52	15	36
5A	171717	16	35	21	38	57	1	30	-6	57	28	62	33	18	42	20	63	8	60	10	39
6A	202020	17	48	26	49	69	-8	50	-12	71	39	75	39	16	52	11	78	-3	75	2	38
7A	222222	17	55	29	61	79	-13	56	-19	83	53	90	45	13	59	7	90	-11	87	-7	37
8A	202020	15	48	29	51	69	-8	49	-14	71	42	75	40	15	52	11	80	-3	76	2	41
9A	171717	18	42	26	44	63	1	43	-9	57	28	65	34	18	45	17	69	6	65	10	41
10A	151515	14	35	18	31	49	2	36	-4	47	20	52	30	22	35	24	54	12	56	8	39
11A	121212	14	24	14	21	38	7	30	1	33	8	41	24	25	27	29	41	23	40	24	38
12A	101010	17	17	9	12	27	14	22	4	21	-1	32	16	26	19	33	30	30	29	31	37
13A	70707	13	17	9	5	16	20	15	0	13	-8	25	13	31	12	29	18	29	17	34	34
76	70707	15	29	23	21	25	29	25	10	34	12	33	24	32	21	47	26	44	30	48	52
77	121212	13	44	29	35	48	16	38	3	57	32	55	36	27	37	35	51	29	50	31	51
77A	151515	15	49	35	44	58	11	43	1	65	34	65	38	25	44	31	61	20	59	27	53
78	171717	16	54	40	50	67	7	49	-2	75	46	74	43	23	50	23	71	17	72	19	54
78A	202020	15	65	42	60	76	-2	58	-9	88	61	88	47	20	58	19	87	9	86	10	56
79	222222	15	72	46	72	90	-2	64	-12	98	69	99	57	17	69	14	100	-1	96	2	57
80	252525	15	81	54	82	100	-13	74	-17	114	78	112	64	15	77	10	113	-7	109	-6	59
80A	252525	17	80	54	84	103	-12	73	-16	115	78	111	64	16	77	10	116	-8	109	-5	57
81	272727	14	86	57	91	116	-19	78	-19	131	88	122	70	12	87	2	127	-18	122	-12	59
81A	272727	14	87	56	92	114	-18	78	-22	128	88	123	67	13	86	2	128	-14	123	-10	59
82	303030	15	104	67	102	124	-23	88	-25	147	102	138	74	8	95	-2	125	-21	136	-17	60
82A	303030	15	100	64	103	126	-24	88	-23	147	102	141	75	8	94	-2	126	-25	139	-19	60
83	323232	15	110	69	114	140	-29	96	-28	171	115	154	83	6	109	-9	143	-32	154	-23	62
83A	323232	17	111	71	115	143	-32	97	-29	175	116	155	86	7	109	-9	140	-30	154	-21	63
84	353535	15	126	86	134	170	-35	113	-30	212	139	169	106	8	132	-15	175	-36	174	-33	68
84A	353535	17	131	88	133	167	-35	116	-32	212	139	169	106	6	138	-15	178	-40	176	-30	71

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		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
84B	353535	15	136	86	136	164	-38	118	-32	224	146	171	114	8	147	-15	187	-40	184	-33	70
84C	353535	18	138	90	137	164	-37	118	-32	226	144	170	114	7	149	-12	190	-37	186	-33	71
85	373737	15	148	96	152	175	-41	135	-36	287	164	190	132	6	183	-18	232	-45	225	-39	73
85A	373737	14	148	96	154	175	-39	134	-34	297	167	189	136	8	194	-14	239	-45	230	-38	73
86	353535	15	141	92	147	168	-33	132	-29	290	156	180	137	14	195	-9	233	-33	225	-28	73
87	323232	15	127	84	133	155	-30	124	-25	276	144	169	131	15	184	-2	218	-27	211	-23	72
88	303030	15	119	76	124	144	-21	116	-23	259	134	154	124	18	174	5	205	-20	196	-17	72
89	272727	16	113	76	114	135	-18	112	-19	242	121	144	119	22	167	10	192	-13	184	-7	72
90	252525	13	103	66	103	123	-11	104	-14	225	109	129	113	23	156	16	175	-9	172	-4	69
91	222222	15	91	60	92	110	-6	95	-9	207	96	118	104	26	146	23	160	4	156	6	72
91A	202020	15	81	52	85	99	1	88	-3	190	84	103	99	28	134	28	145	10	143	16	73
92	171717	15	75	49	76	87	7	82	0	170	71	89	91	33	124	31	129	20	130	24	69
92A	151515	15	64	42	63	77	12	74	4	152	56	75	84	36	109	34	113	28	112	30	70
93	121212	14	56	37	53	63	19	67	8	132	44	64	77	38	99	41	95	36	99	38	69
94	70707	17	35	23	32	35	32	48	20	93	16	34	60	44	75	56	61	53	63	52	70
95	70707	11	51	41	46	40	37	54	15	114	32	47	67	44	76	62	61	60	63	65	77
95A	121212	11	67	49	58	59	25	63	9	142	54	69	81	37	94	54	87	46	88	53	79
96	171717	13	76	56	71	80	13	76	2	176	76	90	90	34	111	42	114	30	116	39	79
96A	222222	13	101	77	97	105	2	95	-6	214	104	118	106	28	139	31	155	16	150	23	83
97	272727	15	117	86	115	129	-11	112	-14	254	129	145	121	25	160	19	185	0	176	9	84
97A	323232	13	139	97	138	154	-22	130	-24	295	154	172	138	19	185	9	220	-20	211	-8	84
97B	353535	12	149	104	148	165	-28	136	-30	325	168	185	146	15	199	3	240	-30	230	-16	84
98	373737	15	161	108	159	180	-34	145	-32	361	187	203	172	16	245	4	282	-37	266	-26	88
99	373232	13	141	97	141	170	-30	137	-29	376	188	214	188	20	276	6	307	-40	301	-34	93
100	372727	15	121	83	120	157	-23	129	-23	374	184	210	189	21	276	7	305	-37	303	-31	94
100A	372727	13	121	85	120	158	-27	128	-22	372	184	210	190	21	276	7	306	-40	302	-30	94
100B	372727	14	120	75	117	154	-26	125	-23	375	184	209	191	21	279	8	310	-40	310	-31	94
100C	372727	13	118	76	116	155	-25	126	-23	375	179	212	191	19	280	10	309	-40	313	-33	94
101	372222	14	98	64	97	142	-19	116	-16	371	179	207	189	22	276	8	304	-33	308	-28	94
101A	372222	14	98	64	96	140	-20	115	-16	371	178	206	189	25	276	10	302	-34	304	-30	94
102	371717	16	72	47	75	129	-11	110	-9	361	169	201	183	23	269	14	298	-30	302	-26	96
102A	371717	14	71	47	74	128	-13	108	-7	356	168	195	183	24	269	14	296	-30	301	-24	94
102B	371515	15	57	38	62	120	-8	103	-5	351	162	192	176	26	265	17	290	-30	295	-26	97
102C	371515	15	60	40	62	122	-9	105	-5	352	162	191	180	26	265	15	290	-30	296	-21	98
103	371212	15	46	33	52	117	-4	98	-1	350	158	193	175	27	266	19	288	-25	295	-20	98
103A	371212	17	45	34	50	117	-3	98	0	347	160	191	176	27	264	18	286	-27	296	-21	98
103B	371010	15	36	27	40	110	0	93	3	345	156	189	176	27	262	19	283	-24	291	-19	99
103C	371010	15	35	27	38	112	0	95	4	343	158	189	176	28	262	20	280	-25	294	-20	99
104	370707	14	25	20	30	105	1	93	5	339	154	185	175	28	258	21	278	-22	289	-18	98
104A	370707	15	24	19	30	106	1	92	4	341	156	188	174	28	259	23	278	-22	288	-18	98
105	320707	14	27	21	27	95	9	87	8	318	139	171	166	33	246	30	257	-12	270	-9	98
106	270707	13	26	23	28	84	11	78	10	287	118	149	155	34	226	38	228	0	245	3	94
107	220707	15	31	22	28	75	17	72	14	257	99	130	145	41	207	48	200	12	220	14	96
108	150707	15	32	22	30	56	22	60	15	205	65	95	126	48	175	56	156	30	176	31	94
109	70707	15	34	24	30	39	32	50	20	153	29	63	109	53	140	69	110	46	136	48	93
114A	70707	11	72	55	62	57	50	66	31	196	67	85	134	57	157	84	130	69	154	70	124
115	120712	8	72	56	63	65	47	71	30	225	85	103	144	56	173	81	156	57	178	59	130
116	170717	11	72	55	63	73	42	77	28	256	104	120	154	51	196	77	184	44	204	48	127
117	220722	10	75	56	64	82	40	85	26	285	121	139	163	47	215	63	213	33	230	34	131
118	250725	13	73	54	69	86	38	86	26	301	134	149	172	45	224	59	227	27	243	31	133
119	270727	12	72	52	68	90	36	88	26	317	142	160	176	41	237	55	244	23	259	23	133
120	300730	8	75	49	70	95	35	91	24	333	152	171	186	38	249	54	259	16	273	19	134
121	320732	11	75	47	70	100	31	95	23	352	159	181	192	36	264	49	275	9	285	11	134
122	350735	11	76	46	73	106	30	98	28	370	172	192	201	37	276	48	295	6	305	6	134
123	370737	9	76	46	72	114	29	98	25	391	181	204	214	36	297	46	318	-2	326	0	134
123A	400740	11	79	46	75	118	25	98	24	417	196	220	226	35	322	41	347	-7	354	-6	134
123B	370737	10	75	43	73	117	26	95	25	409	193	215	226	38	321	45	344	-3	350	1	134
123C	370737	12	62	29	68	114	27	92	24	405	191	212	226	41	329	47	350	-1	356	-2	134
124	350735	11	62	29	64	107	29	87	26	393	180	203	224	43	321	54	340	7	345	3	134
125	320732	11	64	32	64	103	30	84	26	381	169	194	220	47	312	56	327	15	335	11	134
126	300730	14	67	31	75	100	33	78	27	362	157	183	212	47	302	61	308	19	320	14	134

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		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
127	270727	14	55	29	57	94	34	76	26	345	145	173	205	50	289	64	295	21	306	22	136
128	250725	13	52	24	54	88	38	75	29	327	134	160	196	53	276	69	279	30	293	28	133
129	220722	13	51	16	59	80	38	66	29	309	120	149	191	56	264	71	262	36	279	33	131
130	170717	13	44	19	45	71	42	61	29	272	96	124	173	60	239	81	229	51	248	44	134
131	120712	13	39	14	41	59	47	56	31	232	72	102	161	66	217	91	198	61	216	58	131
132	70707	12	32	11	36	50	51	48	31	192	44	75	144	68	189	103	163	72	184	68	130
133	70707	13	31	9	25	37	54	38	27	177	42	74	136	71	169	107	139	92	166	82	131
134	71207	11	47	17	41	50	46	46	21	187	44	78	140	68	174	105	150	87	171	78	130
135	71707	13	62	21	55	60	39	56	14	193	51	82	145	71	181	101	157	84	179	72	130
136	72207	13	75	32	73	76	32	66	9	202	54	89	151	72	187	98	167	79	188	68	131
137	72507	13	81	36	78	80	28	68	3	204	55	90	151	68	192	98	168	75	192	65	131
137A	202520	11	93	39	91	107	20	83	0	232	108	142	185	62	249	81	208	48	233	40	133
138	202720	13	99	48	100	114	14	88	-4	300	115	146	190	61	257	79	258	47	271	36	134
139	203020	13	110	51	104	120	12	93	-6	305	118	151	194	64	259	78	260	42	272	34	136
140	203220	15	118	54	117	132	7	98	-9	310	119	154	196	62	264	78	268	43	281	33	138
141	203520	15	123	60	120	137	2	105	-12	315	124	159	201	63	271	79	276	40	284	30	134
142	203720	15	133	66	128	147	2	112	-14	332	126	163	205	66	278	79	285	38	291	26	139
142A	173717	13	134	58	137	145	0	109	-16	329	124	158	208	65	277	79	285	39	293	28	137
142B	153715	14	131	59	133	140	0	108	-16	315	109	150	205	68	269	82	270	46	279	32	134
142C	153715	14	131	58	129	137	5	106	-15	300	104	142	200	71	261	89	258	52	268	39	136
143	153515	14	123	54	124	129	8	101	-9	295	98	135	196	72	256	90	255	55	262	41	134
144	153215	13	117	49	116	123	12	98	-6	291	97	133	195	73	255	92	248	60	261	44	137
145	153015	13	110	48	110	118	17	94	-2	287	92	133	194	74	252	94	242	61	256	47	137
146	152715	15	99	43	102	110	20	91	1	282	93	129	190	75	248	95	238	64	249	49	137
147	152516	13	91	35	89	105	22	85	4	276	86	122	186	73	243	98	233	70	245	53	137
147A	72507	13	85	30	83	86	30	73	6	214	48	85	166	78	204	108	180	85	194	68	134
148	72207	13	77	24	75	79	35	67	10	210	46	85	161	77	199	108	176	87	193	71	136
149	71707	15	59	14	55	67	42	59	15	197	35	78	156	78	192	111	166	94	182	74	137
150	71207	15	42	4	38	50	48	49	21	188	29	71	151	78	183	115	155	100	174	81	135
151	70707	13	26	-4	22	38	56	41	29	181	25	65	145	78	177	114	146	100	166	83	134
152	70707	15	29	-11	20	33	68	34	38	180	24	66	143	83	169	125	135	114	162	94	149
152A	120000	15	49	-1	41	54	56	48	30	225	52	88	163	81	199	116	177	99	196	80	151
153	170000	16	68	14	64	78	42	63	21	271	82	120	181	76	232	109	218	83	236	64	152
153A	220000	16	89	26	85	103	35	79	14	319	111	148	202	73	266	98	263	68	276	51	156
154	270000	17	111	39	109	126	22	97	7	369	143	175	226	72	303	91	307	52	313	33	154
154A	300000	13	131	59	122	140	17	105	0	411	165	204	246	68	331	85	337	45	345	26	157
154B	320000	15	137	64	131	154	10	113	-4	440	183	215	260	68	356	83	368	37	373	19	158
154C	350000	15	146	77	147	183	9	123	-4	496	218	250	323	73	459	84	502	40	521	29	154
155	370000	14	158	88	160	204	2	131	-10	553	265	275	364	77	517	86	565	40	588	29	159
156	400000	17	170	106	179	240	-1	145	-11	622	320	314	436	78	609	91	660	39	681	28	163
156A	400000	17	181	123	198	274	0	155	-12	677	454	392	520	81	686	99	716	44	753	25	171
157	420000	16	196	135	212	296	-4	162	-17	722	493	453	550	83	727	97	764	38	805	24	173
158	450000	15	346	351	482	657	-28	322	-36	1125	1125	1195	1080	15	1319	51	1303	13	1305	-15	227
158	450000	16	359	366	498	679	-29	341	-36	1137	1147	1205	1097	8	1337	49	1314	12	1316	-16	228
158	450000	17	366	374	504	693	-28	348	-37	1143	1154	1212	1106	8	1344	50	1320	10	1321	-13	231
159	420000	17	351	373	501	679	-22	346	-30	1114	1128	1179	1093	9	1309	51	1290	10	1290	-7	229
160	400000	16	352	367	492	669	-18	338	-27	1083	1102	1149	1076	15	1277	61	1253	25	1259	2	231
161	370000	15	343	360	481	658	-9	330	-22	1052	1075	1115	1056	14	1244	66	1218	32	1228	10	229
161A	370000	15	344	361	484	656	-11	328	-22	1047	1070	1109	1056	13	1239	67	1215	32	1222	10	227
161B	370000	16	357	367	497	663	-8	337	-20	1063	1084	1113	1071	13	1254	65	1229	30	1235	11	234
161C	370000	15	363	374	504	687	-8	358	-15	1086	1117	1125	1095	12	1287	68	1257	27	1263	8	247
161D	370000	15	381	396	531	687	-3	358	-12	1085	1115	1125	1091	13	1283	70	1258	27	1251	9	250
161E	370000	15	395	394	531	690	-2	361	-14	1087	1118	1132	1095	13	1286	70	1256	26	1253	8	251
162	350000	15	376	393	523	682	5	358	-7	1059	1095	1106	1080	15	1258	78	1225	35	1225	16	252
163	320000	17	364	383	514	669	10	349	-4	1030	1068	1075	1063	17	1223	83	1193	40	1195	22	252
164	270000	17	343	368	492	646	22	336	7	964	1008	1007	1021	23	1149	92	1115	54	1121	42	248
165	220000	13	325	350	470	614	37	323	19	892	945	925	973	24	1064	101	1024	68	1036	54	247
166	170000	15	299	340	450	593	48	310	27	806	871	831	919	28	966	111	922	84	941	69	245
167	120000	16	277	325	424	565	62	293	36	731	796	735	863	33	872	120	826	98	851	84	243
168	70000	15	251	308	404	530	70	276	43	653	714	635	802	37	769	129	730	110	756	97	242
169	120000	15	269	319	422	552	61	291	33	712	768	700	841	32	843	121	814	98	821	83	244

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
169A	120000	14	267	322	420	553	61	288	37	707	771	695	835	21	839	115	813	97	821	82	244
170	170000	17	294	337	440	579	50	305	26	777	838	781	886	28	929	111	906	83	904	69	244
171	220000	15	311	354	461	600	39	320	19	854	915	870	946	26	1029	105	1005	70	994	54	248
171A	220000	15	329	361	473	612	40	327	17	875	936	886	966	26	1042	107	1024	70	1015	54	254
172	252222	14	323	360	474	626	40	328	16	917	976	929	992	23	1089	102	1066	65	1056	51	254
172	272222	13	322	362	470	624	39	331	17	917	976	927	993	24	1091	105	1067	64	1056	51	254
173	302222	15	317	358	469	627	37	333	14	940	999	954	1006	20	1115	100	1092	60	1080	43	254
174	322222	16	315	356	467	633	34	334	13	966	1023	985	1023	18	1139	96	1125	54	1114	40	257
175	352222	14	316	353	469	634	30	338	14	996	1047	1015	1043	18	1183	91	1158	50	1143	33	260
176	372222	14	315	348	470	650	27	341	10	1027	1078	1052	1061	15	1217	86	1190	47	1178	30	261
177	352222	15	318	356	470	669	22	357	9	1057	1115	1092	1081	8	1249	84	1227	40	1214	23	262
178	322222	17	319	361	472	665	27	358	11	1030	1095	1072	1069	15	1225	85	1206	46	1195	29	259
179	302222	16	317	356	472	655	29	354	11	1007	1068	1045	1056	16	1202	91	1179	50	1168	32	258
180	272222	15	314	348	468	650	31	349	12	977	1043	1019	1043	18	1172	91	1151	55	1143	38	254
181	252222	15	316	347	466	648	35	346	15	945	1015	988	1026	18	1142	101	1118	61	1113	44	257
182	222222	15	311	342	464	648	37	342	16	916	986	954	1008	26	1108	106	1081	70	1081	50	254
183	222222	17	309	337	467	635	40	338	19	886	957	925	994	26	1076	110	1048	70	1049	57	254
183A	222222	15	306	335	462	629	39	334	20	876	948	915	986	27	1072	110	1045	72	1046	57	253
184	250000	17	316	344	472	639	42	340	11	904	974	947	1006	26	1107	107	1084	67	1076	49	254
185	270000	17	325	349	481	650	25	348	7	935	1002	983	1026	21	1145	101	1123	60	1115	39	254
186	300000	17	331	358	495	660	20	355	4	969	1033	1018	1049	21	1184	95	1166	50	1154	30	253
187	320000	14	345	366	511	673	13	363	-4	1005	1066	1057	1070	19	1226	91	1207	43	1191	24	254
188	350000	17	357	380	524	695	4	378	-9	1041	1100	1093	1098	18	1268	89	1249	40	1234	14	260
189	370000	15	369	389	544	720	0	398	-13	1082	1141	1153	1116	16	1304	82	1293	31	1276	13	257
189A	370000	16	381	404	559	730	0	404	-12	1089	1155	1160	1123	18	1308	88	1295	34	1276	12	254
189B	370000	13	431	457	591	755	-2	427	-20	1147	1198	1188	1149	12	1326	80	1318	31	1298	14	257
189C	370000	11	436	455	594	760	-8	431	-24	1144	1198	1183	1154	8	1324	78	1315	28	1298	12	260
189D	370000	11	445	468	602	768	-5	436	-29	1156	1210	1190	1160	7	1334	80	1326	30	1307	9	261
189E	370000	11	467	488	619	790	-2	458	-22	1185	1241	1213	1179	6	1359	81	1350	28	1331	10	272
189F	370000	13	466	489	622	796	-1	464	-22	1195	1239	1215	1185	8	1371	85	1363	29	1343	8	274
189G	370000	13	464	488	624	797	-1	466	-22	1193	1251	1232	1185	8	1371	85	1363	29	1343	8	274
189H	370000	10	465	488	624	800	-4	466	-22	1192	1248	1228	1186	8	1369	84	1362	30	1343	7	274
189G	370000	12	468	490	632	1126	-1	473	-22	1201	1258	1238	1191	8	1378	89	1370	31	1350	8	273
189H	370000	9	471	500	634	813	-3	483	-25	1206	1264	1244	1193	11	1383	88	1374	32	1351	5	271
190	400000	14	481	516	649	837	-10	504	-29	1241	1306	1293	1213	7	1417	84	1410	27	1383	1	274
191	420000	10	496	531	666	862	-15	524	-36	1277	1348	1349	1231	6	1459	79	1452	20	1411	-9	272
192	450000	9	507	545	682	896	-22	548	-39	1317	1395	1410	1254	0	1507	74	1500	14	1443	-15	273
193	470000	11	521	577	704	935	-30	578	-43	1370	1452	1484	1291	-13	1567	69	1550	8	1480	-21	274
193	470000	10	527	586	706	937	-28	578	-44	1375	1457	1491	1291	-16	1569	68	1550	6	1482	-22	274
194	500000	11	547	616	733	983	-38	618	-49	1424	1525	1567	1322	-32	1636	64	1605	-2	1523	-26	274
194	500000	12	554	622	737	988	-36	628	-50	1425	1526	1579	1330	-36	1642	62	1608	0	1526	-26	276
195	300000	11	466	559	654	888	16	574	-10	1113	1252	1247	1123	-20	1283	104	1250	56	1192	30	270
196	400000	11	508	586	698	939	-10	605	-29	1260	1387	1415	1226	-31	1464	85	1433	27	1351	4	274
197	430000	11	531	610	721	967	-20	617	-37	1341	1444	1511	1284	-38	1563	74	1527	14	1444	-12	274
198	500000	11	565	646	763	1019	-34	663	-47	1430	1555	1641	1337	-56	1665	66	1623	0	1531	-28	278
199	520000	11	591	683	787	1077	-43	714	-51	1489	1633	1695	1385	-82	1741	58	1687	-7	1586	-37	278
199	520000	9	610	706	802	1100	-43	743	-54	1500	1650	1708	1394	-91	1763	55	1696	-11	1596	-37	279
200	550000	12	646	746	843	1155	-51	806	-59	1570	1738	1718	1434	-107	1844	49	1763	-22	1650	-48	282
200	550000	13	667	776	867	1194	-53	858	-59	1625	1845	1728	1465	-117	1899	45	1807	-27	1684	-56	282
200	550000	11	680	800	874	1247	-57	922	-59	1659	1916	1735	1499	-138	1956	36	1843	-30	1721	-58	282
200A	550000	11	689	847	951	1293	-57	986	-55	1686	1978	1760	1433	-158	2021	32	1889	-33	1752	-60	281
200A	550000	13	713	919	998	1390	-54	1090	-51	1725	1958	1769	1378	-183	2126	29	1950	-39	1832	-61	280
200A	550000	13	716	907	939	1444	-53	1201	-43	1751	1970	1772	1486	-179	2223	43	1992	-32	1881	-59	284
200A	550000	13	720	956	952	1483	-57	1257	-40	1751	1972	1774	1536	-185	2265	49	1988	-27	1901	-55	284
200A	550000	13	721	956	956	1494	-52	1267	-38	1747	1971	1773	1543	-184	2262	51	1980	-30	1905	-53	286
200B	550000	11	724	970	963	1520	-57	1300	-41	1766	1978	1783	1570	-198	2299	43	1990	-34	1935	-61	283
201	600000	14	685	906	883	1432	-20	1247	-14	1457	1697	1411	1395	-166	1939	74	1683	6	1631	-16	280
202	600000	13	527	743	751	1180	30	1158	21	1007	1233	841	1013	-115	1422	113	1266	67	1172	41	272
202A	600000	10	537	778	749	1210	30	1149	18	987	1217	835	1002	-116	1392	111	1224	64	1141	42	271
203	300000	8	579	821	802	1222	5	1182	0	1191	1408	1069	1160	-138	1641	93	1430	37	1345	14	273
204	400000	13	643	879	871	1344	-21	1218	-17	1414	1643	1350	1345	-161	1926	76	1658	10	1583	-13	276

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 101	CHAN 102	CHAN 103	CHAN 104	CHAN 105	CHAN 106	CHAN 107	CHAN 108	CHAN 109	CHAN 110	CHAN 111	CHAN 112	CHAN 113	CHAN 114	CHAN 115	CHAN 116	CHAN 117	CHAN 118	CHAN 119	CHAN 120
205	500000	8	709	947	945	1490	-45	1292	-33	1650	1885	1711	1514	-151	2199	55	1883	-20	1836	-40	282
206	520000	11	726	970	968	1536	-49	1328	-37	1702	1955	1830	1552	-199	2256	51	1930	-26	1893	-46	284
207	550000	11	747	1005	993	1590	-58	1377	-44	1738	1998	1868	1600	-214	2327	42	1977	-35	1958	-56	286
208	570000	12	783	1064	1042	1623	-67	1449	-49	1783	1996	1889	1656	-223	2410	34	2017	-47	2033	-66	290
208	570000	13	738	1073	1048	1628	-68	1463	-52	1796	1993	1885	1650	-251	2436	27	2029	-49	2046	-66	291
208	570000	13	731	1080	1053	1629	-68	1470	-52	1803	1986	1885	1653	-247	2437	28	2036	-48	2052	-68	291
209	370000	12	681	981	937	1477	-18	1389	-15	1348	1556	1313	1326	-152	1908	69	1589	8	1596	-10	286
209	370000	11	681	981	934	1476	-19	1382	-16	1349	1553	1312	1322	-154	1899	67	1585	4	1594	-8	288
210	500000	13	751	1033	1004	1556	-49	1426	-39	1627	1820	1669	1532	-224	2229	43	1850	-27	1866	-44	292
211	550000	10	781	1071	1040	1604	-60	1446	-49	1735	1947	1833	1625	-239	2373	31	1970	-41	1993	-59	291
212	570000	9	791	1099	1059	1655	-69	1488	-55	1789	1991	1882	1654	-247	2439	29	2020	-50	2055	-68	294
213	600000	11	822	1205	1094	1688	-72	1624	-54	1837	1985	1886	1724	-246	2585	24	2098	-60	2163	-83	308
213	600000	8	832	1221	1121	1690	-77	1652	-54	1851	1978	1880	1736	-251	2727	21	2115	-62	2184	-79	307
213	600000	10	837	1221	1128	1692	-75	1656	-53	1853	1981	1882	1739	-251	2748	21	2120	-62	2186	-78	306
213	600000	12	843	1225	1132	1693	-75	1664	-52	1856	1978	1878	1742	-249	2791	21	2115	-61	2191	-80	311
214	620000	11	1076	1496	1702	1762	-111	1750	-74	1873	2005	1889	1868	-261	4399	14	2185	-67	2220	-70	304
214	620000	12	1086	1466	1714	1760	-114	1748	-76	1877	2005	1890	1879	-262	4559	14	2178	-70	2220	-71	308
215	650000	13	1308	1691	1902	1907	-158	1918	-125	1885	1978	1878	2018	-281	5740	-12	2183	-95	2248	-86	308
215	650000	11	1329	1705	1936	1920	-161	1931	-129	1887	1979	1873	2026	-284	5802	-12	2185	-100	2252	-86	309
216	670000	11	1739	2026	2391	2192	-151	2222	-138	1894	1988	1840	2216	-313	6962	-29	2197	-122	2299	-115	314
216	670000	13	1781	2051	2417	2206	-150	2232	-140	1894	1993	1865	2224	-316	7104	-31	2193	-126	2306	-114	314
216	670000	12	1821	2077	2434	2216	-152	2242	-136	1894	1998	1879	2232	-312	7301	-31	2189	-127	2311	-116	313
217	700000	12	2110	2260	4154	2346	-158	2364	-151	1915	2022	1895	2376	-364	8069	-50	2159	-145	2349	-127	312
217	700000	13	2329	2292	5027	2475	-152	2463	-150	1912	2015	1875	2413	-371	8069	-53	2140	-149	2312	-134	310
218	720000	10	2721	3163	8084	5375	-145	2753	-150	1927	2033	1903	2411	-418	8069	-42	2082	-159	2304	-145	302
219	750000	12	2749	4935	8084	7780	-147	2865	-154	1936	2040	1907	2448	-471	8069	-60	2471	-175	2324	-155	290
219	750000	13	2744	5741	8084	7780	-150	2876	-156	1937	2046	1903	2474	-487	8069	-65	8060	-149	2346	-151	286
220	770000	8	4131	8308	8084	7780	-152	6514	-140	1956	2036	1935	2573	-524	8069	-86	8060	-161	2343	-156	271
220	770000	5	4124	8308	8084	7780	-158	7242	-139	1956	2015	1915	2572	-534	8069	-96	8060	-164	2325	-162	260
221	400000	5	3134	8308	8084	7780	-86	8058	-83	931	733	840	1939	-404	8069	-22	8060	-66	1226	-66	261
222	600000	6	3591	8308	8084	7780	-120	8058	-110	1531	1423	1328	2341	-462	8069	-65	8060	-120	1816	-112	263
223	750000	7	4078	8308	8084	7780	-165	8058	-140	1923	1934	1999	2478	-531	8069	-115	8060	-159	2288	-152	258
224	770000	7	4034	8308	8084	7780	-180	8058	-150	1875	1913	2038	2425	-572	8069	-137	8060	-169	2316	-159	250
225	800000	7	4012	8308	8084	7780	-210	8058	-172	1863	1915	1963	2461	-653	8069	-189	7970	-209	2330	-175	224
224	820000	7	4029	8308	8084	7780	-168	8058	-184	2784	1343	1711	2462	-774	8069	-251	8060	-205	2373	-192	202
224	820000	8	4031	8308	8084	7780	-243	8058	-186	2697	4934	1573	2449	-795	8069	-268	8060	-209	2366	-193	197
224	820000	7	4024	8308	8084	7780	-240	8058	-186	2610	1923	1539	2444	-791	8069	-268	8060	-206	2366	-194	198
226	820000	7	4040	8308	8084	7780	-247	8058	-187	2675	1965	1510	2473	-817	8069	-283	8060	-209	2366	-195	194
227	850000	5	4075	8303	8084	7780	-228	8058	-273	2637	2085	1228	2445	-1406	8069	-1441	8060	-281	2383	-256	218
227	850000	6	3931	8308	8084	7780	-241	8058	-257	2614	2156	992	2154	-1350	8069	-1002	8060	-226	2386	-273	180
227	850000	7	3745	8308	8084	7780	-228	8058	-234	2551	2195	954	2104	-1218	8069	-856	8060	-164	2364	-225	152
227	850000	7	3575	8308	8084	7780	-204	8058	-200	2592	2221	935	2079	-1112	8069	-736	8060	-120	2364	-180	134
228	850000	5	3435	8303	8084	7780	-130	8058	-207	2259	2256	1220	2121	-1182	8069	-698	8060	15	2345	-100	144
228	850000	-1	3273	8309	8084	7780	-117	8058	-209	1820	2204	1265	2103	-965	8069	-698	8060	55	2326	-70	152
229	540000	2	3239	8305	8084	7780	-115	8058	-209	2196	2188	1263	2083	-875	8069	-704	8060	60	2301	-57	154
229A	540000	2	3246	8308	8084	7780	-114	8058	-207	2206	2193	1261	2084	-868	8069	-702	8060	65	2301	-57	156
230	600000	3	3391	8308	8084	7780	-98	8058	-213	2379	2272	1224	2070	-456	8069	-809	8060	68	2341	4	192
231	660000	5	3621	8308	8084	7780	-70	8058	-202	2174	2585	1191	2092	-324	8069	-601	8060	80	2386	14	212
232	710000	3	3841	8308	8084	7780	-67	8058	8410	4134	8188	1205	2171	-349	8069	-668	8060	174	2428	7854	142
233	608342	1	4049	8308	8084	7780	-92	8058	8410	4357	8188	1193	2370	-377	8069	-728	8060	154	2381	7854	132
234	608595	3	4027	8309	8084	7780	-94	8058	8410	4393	8188	1195	2471	-391	8069	-738	8060	148	2416	7854	133
235	608787	1	4265	8303	8084	7780	-91	8058	8410	4456	8188	1200	2596	-401	8069	-751	8060	136	2436	7854	132
236	609090	-3	8071	8309	8084	7780	-92	8058	8410	4983	8188	1192	2630	-413	8069	-774	8060	125	2429	7854	133
237	609212	-13	8071	8309	8084	7780	-104	8058	8410	5575	8188	1193	2580	-431	8069	-788	8060	113	2431	7854	126
238	609535	-8	8071	8308	8084	7780	-107	8058	8410	6045	8188	1195	2573	-438	8069	-768	8060	109	2423	7854	131
239	609636	-9	8071	8309	8084	7780	-106	8058	8410	6255	8188	1194	2614	-436	8069	-756	8060	107	2411	7854	130
239	609696	-7	8071	8308	8084	7780	-107	8058	8410	6377	8188	1193	2623	-435	8069	-758	8060	104	2421	7854	130
239	0	-8	8071	8309	8084	7780	-103	8058	8410	6490	8188	1193	2603	-434	8069	-755	8060	100	2422	7854	131
239	0	-7	8071	8309	8084	7780	-107	8058	8410	6575	8188	1193	2616	-433	8069	-749	8060	98	2419	7854	130
239	0	-7	8071	8308	8084	7780	-107	8058	8410	6656	8188	1193	2624	-434	8069	-745	8060	97	2425	7854	130
239	0	-4	8071	8309	8084	7780	-107	8058	8410	6705	8188	1195	2629	-431	8069	-748	8060	94	2433	7854	133

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 121	CHAN 122	CHAN 123	CHAN 124	CHAN 125	CHAN 126	CHAN 127	CHAN 128	CHAN 129	CHAN 130	CHAN 131	CHAN 132	CHAN 133	CHAN 134	CHAN 135	CHAN 136	CHAN 137	CHAN 138	CHAN 139	CHAN 140
1 70707	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1A 70707	4	-2	-3	-1	-1	2	1	0	-1	1	-2	2	3	3	6	3	2	3	3	2
2 101010	2	3	0	5	4	5	6	-1	-5	-3	4	3	5	-4	-5	8	3	-4	1	2
2A 101010	1	2	-1	2	2	5	4	-1	-2	-2	-2	0	-2	-9	-7	4	-1	-5	-3	-1
3 121212	3	6	-1	5	4	8	9	-9	-5	-5	0	0	1	-10	-13	5	2	-16	-4	-1
3A 121212	1	6	1	5	4	6	7	-7	-5	-6	4	6	5	-13	-12	5	2	-17	-3	-4
4 151515	2	12	4	12	12	12	11	-13	-7	-10	14	17	8	-14	-17	15	10	-22	-6	-5
4A 151515	1	13	5	13	10	11	13	-13	-7	-9	12	13	11	-14	-16	15	14	-20	0	0
5 171717	3	17	9	15	15	15	15	-20	-10	-14	18	20	15	-18	-22	22	17	-25	0	1
5A 171717	2	21	9	15	15	17	16	-16	-10	-12	18	21	16	-17	-22	24	20	-27	1	2
6 202020	2	30	18	23	24	26	26	-23	-13	-15	30	38	28	-17	-27	34	32	-31	10	5
6A 202020	2	30	18	24	25	27	27	-22	-13	-16	33	39	28	-14	-27	36	35	-29	12	5
7 222222	2	33	21	30	32	31	30	-25	-17	-22	39	40	33	-21	-30	38	36	-37	14	5
7A 222222	3	35	17	24	31	29	29	-26	-18	-23	34	42	33	-21	-34	42	34	-37	9	5
8B 222222	2	36	22	27	32	31	29	-23	-16	-23	34	41	31	-19	-32	39	35	-37	15	5
8 202020	1	32	19	23	29	27	23	-20	-11	-17	29	35	26	-14	-28	35	32	-29	16	9
8A 202020	2	32	17	24	29	29	24	-16	-10	-15	29	37	27	-15	-28	35	30	-28	16	8
9 151515	3	24	13	15	17	17	16	-3	-2	-5	20	30	22	-4	-18	25	23	-16	16	5
9A 151515	1	24	12	14	19	19	15	-3	-2	-2	20	27	21	-6	-15	25	23	-17	18	7
10 70707	3	13	5	1	4	4	3	15	15	13	8	11	9	7	5	12	12	3	17	8
10A 70707	3	11	3	2	4	5	3	15	18	13	7	11	13	11	4	11	13	5	17	8
13 70707	15	47	46	35	45	42	43	40	45	32	72	71	56	55	30	53	65	44	96	55
13 70707	16	47	44	36	44	41	39	37	44	29	68	65	49	54	30	51	62	46	95	52
14 101010	16	47	44	40	46	45	43	30	41	28	74	70	55	49	25	59	61	35	87	52
14 101010	18	47	46	38	46	45	43	30	40	25	70	68	54	48	22	54	60	34	86	53
15 121212	13	47	43	41	49	49	45	23	34	21	68	67	50	38	15	57	60	23	84	49
15 121212	16	47	46	44	50	47	44	17	35	19	64	61	47	35	16	54	56	20	81	50
16 151515	17	48	44	45	52	50	49	15	28	12	69	66	52	30	7	56	57	15	78	48
16 151515	16	49	44	45	52	51	49	13	26	15	68	67	51	30	9	57	56	13	76	45
17 171717	17	53	51	52	56	52	55	5	20	5	73	71	53	29	3	61	57	6	76	42
17 171717	17	52	47	51	55	55	54	4	21	8	74	74	56	29	3	63	59	7	72	44
18 202020	17	55	55	53	61	59	57	-3	14	0	79	78	58	21	-6	68	62	-4	69	42
18 202020	17	56	54	54	60	57	60	-3	14	0	78	76	55	20	-4	66	60	-2	67	40
19 222222	15	59	55	59	63	61	62	-11	7	-8	79	79	60	16	-12	70	65	-11	66	40
19 222222	15	59	56	57	62	63	63	-12	10	-7	78	79	61	15	-13	69	64	-11	66	41
20 202020	18	54	52	55	58	57	59	-5	15	1	72	74	56	20	-5	64	59	-7	62	37
20 202020	17	55	49	54	55	57	59	-7	15	0	72	73	55	16	-7	63	57	-7	62	40
21 171717	15	51	46	52	55	54	53	-1	23	8	64	63	48	16	-1	54	52	3	62	35
21 171717	17	52	48	52	52	50	53	1	23	5	62	58	46	18	-3	51	49	0	60	35
22 121212	17	44	38	41	42	42	41	11	33	20	54	51	37	20	1C	44	42	13	57	35
22 121212	16	40	38	42	39	37	43	11	34	21	49	46	35	25	6	40	38	13	56	38
23 70707	17	34	28	32	29	30	34	25	44	32	44	40	33	40	25	35	37	25	53	33
23 70707	17	30	28	29	27	29	33	24	44	31	46	42	32	38	27	35	37	27	52	34
26 70707	15	26	22	25	22	25	27	19	44	33	37	30	22	35	21	28	26	24	34	24
26 70707	17	24	23	25	22	24	26	18	42	33	36	30	25	34	22	27	26	22	34	23
27 100710	15	24	22	25	22	24	26	15	41	31	34	29	18	31	23	25	22	22	30	22
27 100710	18	22	22	25	22	24	26	17	40	30	31	28	18	30	24	24	23	25	30	22
28 120712	15	27	30	28	24	24	29	13	40	25	34	27	18	25	21	27	23	24	27	20
28 120712	15	26	24	25	24	25	28	10	39	25	32	28	19	27	22	27	23	24	27	19
29 150715	17	27	26	31	24	26	31	7	35	21	32	25	19	22	24	25	22	23	24	18
29 150715	18	26	26	30	25	27	29	7	35	22	32	26	18	21	24	25	22	23	22	18
30 170717	15	27	25	31	25	29	32	4	33	18	32	30	19	26	27	25	22	22	22	21
30 170717	16	28	24	32	26	31	32	0	34	17	31	24	18	19	25	29	22	24	17	18
31 200720	17	30	26	33	28	32	32	0	30	16	35	26	18	16	25	25	23	23	16	18
31 200720	19	30	26	33	28	31	31	-1	32	13	32	24	17	16	25	28	22	23	16	18
32 220722	17	34	28	34	30	35	35	-3	29	11	35	26	18	14	27	27	22	25	14	19
32 220722	17	32	28	34	30	32	35	-7	28	13	34	26	16	12	26	30	22	23	13	15
33 200720	18	31	27	34	28	32	33	-1	29	14	32	24	16	15	25	28	23	21	10	15
33 200720	17	27	28	33	28	31	33	-3	27	12	28	21	14	13	22	27	20	18	10	14
34 170717	15	27	27	32	30	31	31	0	31	16	30	23	15	14	22	28	21	19	10	14
34 170717	16	27	28	29	24	30	30	0	31	14	31	23	16	15	21	30	22	18	10	15

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

	CHAN 121	CHAN 122	CHAN 123	CHAN 124	CHAN 125	CHAN 126	CHAN 127	CHAN 128	CHAN 129	CHAN 130	CHAN 131	CHAN 132	CHAN 133	CHAN 134	CHAN 135	CHAN 136	CHAN 137	CHAN 138	CHAN 139	CHAN 140
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35 150715	17	26	24	30	25	24	28	3	33	19	28	20	15	15	19	24	21	18	6	13
36 120712	16	24	22	27	22	25	25	9	38	21	28	20	13	18	21	23	22	18	9	14
36 120712	17	24	23	25	23	25	25	7	35	21	28	19	12	17	21	24	22	18	9	13
37 100710	16	22	19	22	19	22	23	12	38	25	24	18	13	20	19	22	21	17	3	11
37 100710	15	22	22	25	20	24	23	9	37	25	25	18	13	18	19	24	20	17	3	10
38 70707	18	26	28	23	37	25	23	20	48	33	32	26	21	33	15	26	32	24	12	12
38 70707	17	27	28	24	35	27	23	19	47	33	35	30	27	32	17	27	33	20	9	12
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51 70707	18	40	36	31	36	31	31	20	61	35	50	44	36	39	18	36	43	25	30	25
52 71007	16	42	39	33	40	35	33	19	57	32	53	46	38	35	11	38	46	18	27	25
52 71007	16	40	38	33	38	32	33	17	55	32	49	45	37	32	12	37	42	17	26	25
53 71207	17	39	36	32	39	35	33	15	54	29	49	46	38	31	4	36	43	7	27	24
53 71207	19	38	35	32	41	32	29	13	54	28	44	44	33	32	2	35	41	11	27	22
54 71507	17	36	36	34	40	32	35	12	50	25	49	46	35	25	-3	40	41	9	18	23
54 71507	18	36	36	32	39	32	34	8	50	23	47	41	37	28	-2	38	41	4	18	23
55 71707	18	36	35	33	38	36	35	5	44	21	48	42	35	23	-8	38	43	-3	16	20
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56 72007	17	37	36	36	41	37	36	2	43	20	49	42	33	16	-17	40	41	-12	11	21
56 72007	17	38	36	37	40	37	36	1	43	19	45	41	33	16	-17	40	43	-14	10	18
57 72207	18	37	34	38	43	37	41	-3	39	19	48	46	35	13	-25	43	43	-19	10	19
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63 70707	15	19	21	23	24	22	23	15	55	25	24	15	13	19	12	19	20	18	-3	13
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7A 222222	14	34	33	43	41	41	44	-35	20	-13	39	35	28	-11	-21	44	34	-25	-33	3
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76 70707	15	30	29	24	30	28	26	24	72	37	49	40	31	44	29	34	40	31	22	29
77 121212	18	39	36	33	38	35	33	6	62	28	54	46	33	35	16	42	40	17	20	24
77A 151515	16	40	37	37	38	37	41	-3	60	21	54	48	35	27	9	43	42	11	17	25
78 171717	15	42	38	40	41	39	37	-13	51	13	53	46	34	20	-3	42	39	3	12	22
78A 202020	15	43	40	45	45	47	46	-20	45	4	58	51	36	14	-7	47	42	-6	12	23
79 222222	16	47	45	45	52	50	49	-26	35	-3	64	56	38	9	-13	50	44	-12	10	25
80 252525	17	51	46	53	55	52	53	-31	31	-9	64	61	42	0	-18	58	50	-17	7	23
80A 252525	16	52	45	54	55	52	54	-33	30	-7	64	59	40	-2	-21	58	47	-20	7	23
81 272727	15	53	48	57	60	55	56	-41	23	-14	68	62	43	-7	-27	63	51	-30	4	22
81A 272727	15	53	49	55	60	56	57	-41	25	-15	63	61	42	-7	-27	61	50	-27	1	21
82 303030	14	61	52	62	68	62	63	-55	9	-34	68	68	48	-13	-35	70	58	-33	0	21
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83 323232	16	63	55	72	72	67	67	-66	0	-45	72	74	52	-19	-43	77	61	-43	-4	19
83A 323232	15	65	54	70	73	68	68	-70	0	-46	73	71	52	-20	-44	79	62	-42	-6	20
84 353535	17	76	64	78	82	76	76	-83	-11	-57	81	90	61	-22	-56	94	75	-52	-3	18
84A 353535	15	76	62	76	84	76	76	-82	-12	-59	84	91	63	-22	-49	94	76	-51	-6	20

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

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84C	353535	14	74	65	79	84	76	77	-87	-11	-64	87	94	67	-25	-53	100	80	-53	-9	13
85	373737	15	82	68	87	93	79	83	-95	-17	-71	94	104	72	-28	-60	112	88	-62	-10	16
85A	373737	14	83	70	89	93	86	83	-95	-18	-73	89	103	73	-29	-58	111	89	-62	-13	15
86	353535	15	79	67	83	90	79	83	-88	-9	-64	86	100	70	-24	-57	108	87	-53	-11	15
87	323232	16	75	64	80	84	73	76	-82	-5	-55	83	96	67	-19	-49	102	81	-47	-13	16
88	303030	14	71	56	72	77	71	73	-77	5	-46	78	88	64	-14	-40	94	79	-40	-13	15
89	272727	16	66	54	72	73	67	69	-71	15	-37	74	85	61	-8	-32	94	77	-32	-11	15
90	252525	16	62	48	65	67	59	65	-65	22	-31	68	80	53	-4	-27	84	69	-26	-15	15
91	222222	18	58	44	62	63	54	59	-55	30	-21	65	74	52	3	-20	82	62	-22	-15	14
91A	202020	16	54	40	58	56	50	54	-48	35	-15	61	68	48	6	-13	74	61	-12	-16	12
92	171717	15	49	39	52	54	46	51	-41	42	-9	53	59	47	10	-7	68	57	-5	-14	10
92A	151515	15	46	34	45	44	41	43	-34	52	0	46	51	38	14	-4	64	52	3	-14	15
93	121212	17	42	27	38	42	37	37	-23	58	5	42	50	37	18	9	57	50	13	-13	15
94	70707	17	32	22	31	31	26	29	-7	63	15	35	39	29	25	17	48	42	25	-13	17
95	70707	17	48	40	40	60	42	39	10	79	25	65	68	53	57	30	64	67	37	24	32
95A	121212	17	56	46	48	65	49	48	-3	65	13	73	80	58	49	19	77	73	26	20	32
96	171717	18	54	40	55	72	52	50	-20	52	-3	81	88	63	35	7	83	77	10	17	32
96A	222222	16	71	61	65	87	67	66	-36	39	-15	90	98	72	24	-8	94	82	-3	16	30
97	272727	18	77	69	73	98	74	76	-53	25	-33	99	107	80	16	-20	104	92	-17	12	28
97A	323232	17	86	73	85	104	86	85	-72	8	-50	108	118	85	3	-36	117	100	-32	12	29
97B	353535	15	91	77	92	113	89	90	-81	-1	-60	111	125	87	-4	-43	124	104	-42	9	25
98	373737	14	96	81	95	121	96	95	-91	-7	-71	113	130	94	-12	-52	132	114	-51	4	25
99	373232	16	89	76	92	113	88	87	-83	-5	-69	102	118	85	-2	-41	124	105	-38	2	23
100	372727	15	84	69	83	107	82	80	-73	9	-62	86	106	77	5	-29	113	97	-23	4	25
100A	372727	14	83	69	84	107	82	81	-72	10	-64	86	106	77	4	-31	113	95	-23	4	28
100B	372727	15	80	66	78	103	77	76	-75	4	-67	82	101	72	3	-28	111	93	-25	-11	18
100C	372727	15	79	64	78	101	76	76	-75	3	-67	82	100	69	1	-30	109	90	-27	-12	19
101	372222	17	72	60	74	94	72	69	-65	15	-61	74	91	63	11	-17	102	86	-13	-13	19
101A	372222	16	74	60	74	94	71	71	-66	15	-62	73	90	63	9	-17	100	82	-15	-13	15
102	371717	16	66	54	65	86	64	65	-55	25	-51	59	75	55	19	-6	87	73	4	-15	15
102A	371717	15	65	49	64	84	64	63	-55	26	-51	60	71	54	20	-3	84	71	-2	-18	15
102B	371515	15	63	46	62	78	59	58	-51	33	-49	50	61	48	22	0	78	67	8	-20	13
102C	371515	15	61	43	64	79	57	58	-50	31	-49	51	64	48	22	2	79	66	7	-21	14
103	371212	15	58	44	59	75	55	55	-43	35	-47	47	58	45	25	9	73	62	17	-24	15
103A	371212	17	59	44	58	76	54	55	-45	37	-46	43	56	43	23	10	72	61	15	-24	14
103B	371010	16	56	40	55	72	51	51	-40	45	-43	40	51	38	28	13	66	56	20	-28	15
103C	371010	17	56	40	55	72	50	51	-41	43	-41	39	49	38	28	12	69	58	18	-28	13
104	370707	15	53	38	53	67	49	45	-36	49	-38	32	52	33	31	30	61	52	27	-26	13
104A	370707	16	52	36	53	69	50	47	-37	49	-39	34	54	35	30	29	62	51	28	-27	13
105	320707	17	53	38	48	64	45	45	-32	52	-32	35	46	35	33	22	60	52	27	-29	12
106	270707	15	48	33	44	61	41	41	-27	53	-25	33	43	34	31	22	59	51	27	-29	12
107	220707	16	47	32	42	60	41	36	-23	60	-17	34	43	32	32	21	58	51	30	-29	14
108	150707	14	42	27	37	51	32	31	-15	64	-5	33	41	28	32	22	58	50	31	-30	11
109	70707	17	36	23	30	48	31	28	-5	65	4	34	41	31	32	25	59	51	31	-33	9
114A	70707	13	62	46	48	79	56	56	13	115	42	88	98	64	78	49	91	86	57	50	45
115	120712	15	66	50	52	81	59	59	4	112	34	89	95	63	70	49	93	82	59	47	45
116	170717	13	66	56	57	83	61	64	-5	107	24	84	95	62	63	45	91	82	58	42	42
117	220722	14	71	60	60	87	63	66	-15	98	13	84	96	59	55	46	94	80	57	36	42
118	250725	13	71	60	63	88	66	65	-21	94	8	83	91	59	53	50	94	79	55	34	40
119	270727	13	71	58	64	88	67	67	-25	92	4	83	90	55	47	50	94	78	56	30	36
120	300730	13	71	59	65	90	69	73	-31	89	-5	79	86	54	42	51	93	75	54	26	34
121	320732	13	72	62	69	94	68	74	-36	84	-8	79	87	53	40	50	93	72	56	20	32
122	350735	13	73	63	74	93	69	74	-42	79	-12	77	86	52	32	50	92	70	55	16	30
123	370737	13	73	62	74	94	72	76	-46	75	-14	74	84	48	26	50	92	67	52	10	28
123A	400740	13	73	62	75	97	72	76	-53	72	-21	73	81	46	22	48	91	67	51	6	25
123B	370737	13	71	59	73	93	69	75	-49	75	-19	70	77	47	24	49	89	62	50	12	22
123C	370737	12	63	54	70	87	65	69	-60	75	-19	57	67	36	18	47	82	65	47	-16	14
124	350735	13	61	49	65	83	62	65	-50	80	-17	54	64	36	19	47	83	55	49	-18	15
125	320732	12	59	49	60	83	59	63	-46	78	-15	52	61	31	21	47	79	54	47	-20	14
126	300730	13	56	46	55	80	59	61	-40	81	-13	50	59	33	22	46	79	51	47	-23	12

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 121	CHAN 122	CHAN 123	CHAN 124	CHAN 125	CHAN 126	CHAN 127	CHAN 128	CHAN 129	CHAN 130	CHAN 131	CHAN 132	CHAN 133	CHAN 134	CHAN 135	CHAN 136	CHAN 137	CHAN 138	CHAN 139	CHAN 140
127	270727	12	51	39	54	76	52	51	-33	81	-13	44	51	27	22	42	74	48	45	-28	10
128	250725	13	48	33	50	73	51	51	-31	85	-6	41	50	27	25	42	74	45	47	-33	8
129	220722	12	44	35	45	69	45	48	-27	85	-5	41	47	23	25	41	69	43	44	-36	7
130	170717	13	42	31	41	64	42	44	-20	92	5	37	44	23	31	42	67	43	46	-38	5
131	120712	13	34	29	38	57	34	35	-11	95	13	35	39	18	35	41	64	40	45	-41	5
132	70707	12	27	22	32	54	29	31	-5	118	19	30	33	16	39	39	62	39	43	-45	4
133	70707	13	30	23	25	44	27	25	-3	125	30	39	45	33	53	49	62	50	56	-48	10
134	71207	14	35	25	28	49	29	30	-10	119	23	43	51	37	48	32	70	55	41	-48	10
135	71707	13	38	29	33	53	32	34	-15	111	16	48	60	42	42	20	77	60	28	-48	11
136	72207	13	42	32	39	58	39	41	-25	104	13	55	68	48	39	6	84	67	13	-49	12
137	72507	13	45	34	38	61	41	40	-29	103	9	58	69	48	32	-3	87	69	6	-49	12
137A	202520	16	53	44	52	71	51	54	-49	85	-12	63	80	55	21	-1	99	74	0	-52	10
138	202720	14	55	46	54	74	56	56	-53	82	-17	69	81	58	16	-7	104	79	-3	-53	10
139	203020	15	58	48	56	82	59	62	-58	75	-20	70	86	62	15	-14	110	81	-13	-53	12
140	203220	13	61	48	61	81	60	63	-63	75	-24	73	91	67	13	-22	112	84	-19	-54	10
141	203520	16	64	51	65	84	62	65	-71	75	-26	78	93	67	8	-28	120	90	-27	-53	11
142	203720	14	69	59	70	88	64	70	-77	72	-26	80	99	72	5	-40	130	97	-35	-54	10
142A	173717	12	70	55	65	84	63	67	-84	68	-30	80	94	67	-5	-48	133	94	-50	-64	5
142B	153715	13	66	54	65	86	61	65	-83	72	-26	77	94	67	0	-47	134	97	-49	-68	5
142C	153715	13	66	52	62	82	59	62	-77	77	-20	74	90	67	3	-47	133	97	-50	-73	3
143	153515	16	62	48	60	81	55	61	-73	83	-15	71	88	64	3	-38	131	92	-53	-73	3
144	153215	13	60	48	57	78	54	57	-70	83	-15	71	83	59	8	-32	126	91	-36	-73	4
145	153015	14	60	46	55	76	52	54	-65	92	-11	65	81	60	11	-24	122	88	-27	-75	3
146	152715	13	56	41	52	72	51	49	-61	91	-10	60	75	54	11	-16	117	82	-22	-76	3
147	152515	14	55	40	49	67	47	46	-57	94	-9	54	68	48	13	-11	111	77	-13	-78	1
147A	72507	15	46	32	39	61	38	40	-43	105	7	52	63	46	25	-7	104	72	-11	-78	-2
148	72207	16	44	29	38	60	37	36	-40	109	10	49	58	45	23	-4	100	72	-5	-83	-3
149	71707	16	40	26	30	50	32	30	-33	114	15	39	48	35	27	9	92	62	8	-83	-5
150	71207	15	32	24	26	45	26	23	-25	122	22	34	40	31	32	25	82	56	24	-85	-4
151	70707	13	28	18	22	40	22	19	-20	128	27	25	30	23	38	30	72	50	37	-84	-5
152	70707	14	26	19	14	38	19	15	-2	141	34	15	28	15	38	40	68	46	51	-64	14
152A	120000	16	32	24	25	46	29	25	-20	132	23	29	43	28	29	27	78	55	40	-63	14
153	170000	17	46	32	33	60	38	36	-36	119	10	35	53	38	16	12	92	61	22	-61	15
153A	220000	17	53	40	48	71	47	46	-55	105	-6	46	66	45	8	-1	102	72	12	-61	13
154	270000	16	64	49	56	81	59	56	-71	91	-21	58	79	54	-4	-17	121	86	-5	-58	17
154A	300000	13	74	58	62	91	67	65	-77	85	-35	69	91	64	-5	-28	130	94	-12	-50	12
154B	320000	16	79	62	71	98	73	68	-88	75	-41	69	96	67	-11	-32	137	101	-19	-50	15
154C	350000	13	73	70	79	114	87	78	-95	72	-49	85	115	80	-7	-37	157	120	-24	-46	15
155	370000	16	103	76	90	131	98	91	-105	65	-59	93	127	91	-8	-42	171	130	-30	-46	19
156	400000	16	129	88	104	149	116	104	-113	58	-72	109	145	103	-11	-47	196	150	-39	-43	22
156A	400000	16	159	102	119	173	139	119	-117	52	-83	124	170	119	-8	-47	247	176	-42	-36	24
157	420000	17	165	107	129	181	151	129	-123	47	-91	133	184	130	-11	-55	239	186	-51	-36	25
158	450000	17	316	293	304	324	369	312	-170	5	-159	413	376	287	-47	-116	403	362	-86	-33	28
158	450000	16	324	237	309	328	378	315	-172	5	-162	424	386	294	-50	-119	414	351	-87	-33	28
158	450000	16	324	301	313	330	380	315	-172	4	-164	426	387	297	-49	-118	417	356	-86	-29	29
159	420000	17	322	296	305	323	377	312	-161	15	-154	421	380	295	-45	-110	410	349	-79	-33	27
160	400000	17	312	288	298	320	371	305	-150	23	-144	414	373	287	-37	-100	403	346	-67	-31	28
161	370000	17	306	284	289	311	363	295	-138	32	-135	404	367	283	-32	-90	394	340	-61	-30	29
161A	370000	17	305	283	292	309	365	295	-138	35	-134	404	369	281	-32	-90	399	342	-59	-29	30
161B	370000	15	310	286	296	316	370	305	-131	43	-128	414	377	287	-23	-78	404	347	-53	-9	38
161C	370000	13	323	302	312	327	385	323	-133	51	-124	442	399	304	-12	-82	422	362	-48	34	55
161D	370000	13	319	298	305	326	381	318	-137	48	-126	442	390	294	-10	-82	420	359	-50	26	49
161E	370000	13	315	295	305	324	378	315	-136	46	-127	442	387	294	-11	-82	420	355	-50	22	45
162	350000	15	311	291	303	321	377	313	-125	55	-117	437	381	291	30501	-72	413	352	-42	20	50
163	320000	13	304	283	295	313	369	305	-117	62	-109	428	371	283	-4	-67	402	342	-35	14	48
164	270000	14	291	274	279	300	355	293	-100	82	-88	411	355	267	6	-48	384	330	-22	22	50
165	220000	13	276	258	265	282	341	275	-78	100	-71	392	337	257	19	-28	364	317	-2	22	50
166	170000	13	262	243	247	267	321	261	-53	118	-47	374	316	246	31	-9	344	302	18	20	50
167	120000	14	248	232	232	252	304	243	-33	133	-27	360	301	235	45	12	331	290	36	19	49
168	70000	15	232	217	215	234	285	229	-11	149	-14	337	284	222	58	32	309	275	54	17	48
169	120000	15	243	228	230	247	297	240	-28	139	-24	353	299	227	45	17	322	281	2	20	47

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 121	CHAN 122	CHAN 123	CHAN 124	CHAN 125	CHAN 126	CHAN 127	CHAN 128	CHAN 129	CHAN 130	CHAN 131	CHAN 132	CHAN 133	CHAN 134	CHAN 135	CHAN 136	CHAN 137	CHAN 138	CHAN 139	CHAN 140
169A	120000	13	246	233	230	250	300	243	-27	138	-24	354	294	226	47	18	324	286	37	22	44
170	170000	14	261	246	243	264	314	260	-27	122	-44	374	313	238	35	2	342	300	22	23	45
171	220000	14	276	259	261	280	331	275	-66	105	-61	392	330	252	25	-16	363	313	6	22	48
171A	220000	13	285	263	270	287	340	286	-63	114	-57	398	338	257	30	-17	370	318	10	41	55
172	252222	13	290	266	275	289	345	289	-70	110	-61	394	331	252	27	-17	364	312	6	36	54
172	272222	13	293	265	275	291	341	289	-70	110	-63	391	330	253	29	-18	363	312	8	34	54
173	302222	15	292	266	278	289	346	292	-74	107	-65	389	328	247	25	-18	396	310	8	33	53
174	322222	13	293	264	279	292	350	294	-80	104	-74	389	329	247	25	-18	363	309	7	27	52
175	352222	17	289	264	283	290	351	294	-82	101	-81	383	326	251	21	-16	363	309	7	21	50
176	372222	14	291	263	285	294	356	295	-87	95	-85	382	325	249	22	-16	362	309	3	17	49
177	352222	16	295	268	289	304	361	301	-91	95	-91	388	331	253	22	-18	366	311	6	15	51
178	322222	15	291	268	285	299	358	300	-90	95	-86	386	330	253	21	-18	365	311	5	12	49
179	302222	13	286	263	282	294	353	292	-85	95	-84	383	328	249	19	-17	364	310	5	10	48
180	272222	16	282	260	280	291	350	290	-81	100	-78	382	321	245	16	-17	362	305	3	7	45
181	252222	15	279	258	273	287	349	285	-75	103	-74	377	320	244	16	-17	361	304	5	6	45
182	222222	16	274	256	272	282	339	283	-71	104	-69	374	318	244	15	-18	358	302	3	5	45
183	222222	17	270	255	269	280	337	282	-70	108	-64	374	317	240	15	-18	358	302	2	2	44
183A	222222	13	265	248	264	273	331	273	-71	105	-67	363	309	233	12	-17	357	296	2	-14	35
184	250000	13	271	253	269	278	337	282	-82	95	-76	374	316	242	6	-18	361	302	-5	-15	34
185	270000	13	278	256	273	284	341	284	-93	88	-88	381	326	246	-1	-34	374	308	-17	-16	64
186	300000	13	281	262	283	293	347	292	-101	79	-94	391	331	253	-5	-42	383	317	-27	-24	31
187	320000	13	292	268	289	299	359	299	-114	69	-107	400	344	259	-16	-55	394	322	-35	-24	31
188	350000	13	301	280	301	307	370	312	-123	61	-115	411	354	264	-19	-64	404	333	-42	-23	33
189	370000	13	312	288	308	316	383	322	-135	48	-132	427	369	276	-26	-71	414	342	-50	-33	31
189A	370000	14	316	291	313	319	386	323	-142	45	-139	428	380	287	-31	-82	428	352	-57	-36	25
189B	370000	15	351	325	332	352	415	347	-131	65	-120	493	442	337	-1	-72	458	400	-42	31	52
189C	370000	13	354	326	341	354	421	355	-136	64	-127	492	440	336	-9	-78	460	402	-45	44	57
189D	370000	14	359	330	343	359	426	355	-143	61	-132	499	446	337	-11	-83	461	402	-51	40	55
189E	370000	15	371	343	354	372	438	372	-141	67	-128	519	460	347	-4	-82	472	415	-43	86	77
189E	370000	13	370	340	354	372	437	372	-140	71	-127	522	461	347	-4	-81	473	412	-44	84	75
189F	370000	12	369	339	353	371	438	373	-146	65	-134	519	454	340	-12	-87	472	405	-52	67	70
189F	370000	13	366	337	352	370	433	372	-148	68	-132	513	450	338	-11	-84	472	402	-52	67	69
189G	370000	13	372	340	357	374	441	377	-147	66	-132	517	455	340	-11	-87	474	407	-51	75	73
189H	370000	13	371	340	357	372	444	375	-152	65	-137	519	453	340	-14	-89	477	407	-53	64	65
190	400000	12	382	348	365	386	451	385	-162	54	-147	529	463	349	-17	-96	488	417	-64	66	65
191	420000	13	398	358	377	390	460	395	-175	44	-161	543	475	356	-22	-105	501	429	-75	62	65
192	450000	13	406	368	388	400	474	405	-186	35	-172	554	486	361	-29	-116	513	440	-85	56	65
193	470000	13	420	381	400	408	489	420	-195	27	-185	571	501	373	-37	-130	531	452	-97	52	61
193	470000	11	423	383	401	404	489	422	-197	25	-185	573	500	377	-42	-129	530	456	-94	56	62
194	500000	13	442	397	411	402	506	440	-205	17	-3395	587	519	390	-47	-138	550	469	-104	*****	63
194	500000	12	444	398	413	416	506	442	-207	20	-196	575	518	389	-49	-140	549	469	-103	53	60
195	300000	13	381	338	349	342	444	375	-121	98	-108	510	440	337	-5	-72	468	411	-36	50	60
196	400000	13	409	3565	380	372	474	403	-163	64	-150	544	477	362	-27	-104	504	437	-69	52	60
197	450000	12	424	380	393	389	489	422	-183	47	-170	561	494	374	-39	-121	524	452	-82	51	59
198	500000	12	446	404	411	408	511	444	-207	22	-194	586	517	391	-23	-138	554	472	-103	50	59
199	520000	13	473	421	429	419	535	464	-220	13	-206	606	537	407	-58	-149	574	492	-116	50	60
199	520000	13	469	442	429	417	544	464	-223	15	-208	608	540	410	-62	-152	584	502	-130	47	58
200	550000	12	509	453	451	427	571	489	-234	8	-221	623	558	422	-69	-163	604	522	-140	47	57
200	550000	12	651	472	465	433	585	508	-228	10	-222	620	559	424	-72	-167	604	522	-142	50	60
200	550000	12	691	482	480	438	600	519	-197	10	-223	617	557	420	-74	-168	604	518	-146	45	59
200A	550000	12	716	526	489	439	607	560	-151	0	-217	654	550	414	-78	-171	603	516	-153	46	60
200A	550000	12	758	546	517	439	624	574	-139	-12	-214	684	553	413	-74	-174	621	522	-162	47	60
200A	550000	13	781	562	635	474	666	587	-137	13	-187	693	610	462	-66	-167	674	590	-162	50	57
200A	550000	13	780	581	639	508	675	586	-123	-31	-241	690	617	474	-78	-169	710	619	-182	49	57
200A	550000	13	780	584	636	509	678	585	-120	-32	-239	688	618	474	-76	-170	703	620	-183	50	56
200B	550000	13	791	591	645	516	684	594	-120	-33	-246	691	623	477	-80	-170	709	622	-183	47	58
201	400000	12	723	534	581	456	634	535	-40	35	-175	634	567	439	-42	-120	641	578	-125	47	57
202	200000	13	601	441	472	348	557	451	63	129	-74	547	477	377	8	-40	534	501	-43	47	57
202A	200000	13	604	444	475	357	561	458	82	149	-58	569	497	394	24	-30	544	519	-31	78	72
203	300000	13	651	482	518	394	596	493	34	106	-102	608	536	421	-1	-62	592	550	-67	76	72
204	400000	13	711	531	574	444	634	539	-15	60	-154	654	582	454	-25	-102	644	590	-109	76	71

THE LOAD STAGE NUMBER USED AS ZERO FOR THIS RUN IS 1

		CHAN 121	CHAN 122	CHAN 123	CHAN 124	CHAN 125	CHAN 126	CHAN 127	CHAN 128	CHAN 129	CHAN 130	CHAN 131	CHAN 132	CHAN 133	CHAN 134	CHAN 135	CHAN 136	CHAN 137	CHAN 138	CHAN 139	CHAN 140
205	500000	13	776	582	628	497	682	585	-60	14	-206	703	630	487	-50	-142	702	636	-149	76	70
206	520000	13	797	597	642	509	697	598	-68	-1	-3419	716	643	497	-61	-153	715	648	-163	76	71
207	550000	13	823	616	664	532	715	610	-80	-17	-237	732	660	511	-66	-164	739	669	-175	72	71
208	570000	13	859	647	705	566	739	635	-104	-28	-254	742	690	534	-95	-201	756	680	-190	70	70
208	570000	13	865	651	712	564	755	638	-105	-25	-254	742	696	539	-94	-202	762	684	-193	69	70
208	570000	13	866	657	715	569	758	639	-105	-25	-255	743	697	540	-94	-200	764	689	-193	72	70
209	370000	13	762	574	615	475	674	554	-6	65	-160	661	616	482	-44	-132	665	617	-117	72	70
209	370000	13	758	572	615	473	672	554	0	70	-154	662	614	486	-47	-133	662	617	-118	72	65
210	500000	13	822	622	673	527	721	603	-65	17	-211	710	660	517	-77	-177	720	652	-165	67	65
211	550000	12	846	644	698	551	746	625	-92	-7	-237	727	685	533	-89	-194	744	676	-185	66	65
212	570000	13	873	669	717	565	764	648	-103	-21	-254	739	690	537	-100	-204	760	685	-198	70	65
213	600000	13	862	728	770	614	811	678	-116	-17	-274	750	688	527	-110	-223	843	768	-193	63	65
213	600000	11	866	739	778	621	819	681	-116	-22	-277	748	690	527	-107	-225	844	772	-191	62	65
213	600000	12	868	743	778	623	819	681	-117	-25	-278	749	694	527	-108	-222	847	775	-192	63	65
213	600000	12	874	748	782	626	823	685	-115	-26	-279	754	692	524	-105	-222	851	780	-193	67	65
214	620000	12	915	809	869	709	900	747	-145	-65	-344	814	756	589	16	-294	904	848	-232	66	64
214	620000	13	910	805	878	712	901	751	-141	-66	-344	810	757	590	6	-187	902	851	-231	68	63
215	650000	12	976	864	942	757	953	804	-161	-65	-366	861	847	621	11	-184	943	910	-222	56	62
215	650000	13	982	866	945	761	958	811	-161	-65	-365	859	848	624	11	-185	944	912	-223	52	59
216	670000	13	1033	935	991	830	1024	869	-166	-130	-411	951	969	722	-15	-265	1000	985	-215	52	59
216	670000	13	1038	945	995	842	1031	874	-165	-145	-421	961	975	726	-14	-267	1011	997	-210	50	63
216	670000	12	1033	956	1005	852	1039	889	-167	-147	-425	974	1017	726	-14	-267	1016	1006	-208	50	60
217	700000	13	1120	1006	1084	918	1096	963	-188	-180	-454	1027	1039	772	-34	-307	1068	1054	-210	49	63
217	700000	13	1134	1020	1100	931	1107	971	-180	-189	-458	1070	1080	791	-30	-313	1076	1060	-204	50	62
218	720000	10	1236	1108	1165	994	1216	1038	-182	-265	-524	1161	1228	925	-74	-332	1196	1181	-122	54	60
219	750000	12	1339	1155	1230	1017	1294	1107	-276	-304	-572	1238	1332	1002	-72	-355	1278	1261	-120	55	62
219	750000	12	1371	1173	1247	1032	1325	1115	-288	-326	-606	1260	1365	1024	-64	-358	1309	1290	-127	54	61
220	770000	13	1421	1252	1318	1100	1386	1195	-331	-402	-721	1368	1497	1124	-15	-431	1453	1439	-207	58	62
220	770000	10	1452	1288	1325	1124	1466	1217	-365	-435	-775	1401	1534	1157	-14	-324	1491	1476	-232	52	55
221	400000	14	1216	1072	1057	928	1288	1009	-77	-206	-535	1183	1270	995	129	-51	1189	1279	-26	120	88
222	600000	14	1354	1205	1203	1060	1396	1128	-200	-315	-674	1304	1409	1087	67	-152	1344	1396	-119	116	85
223	750000	15	1485	1322	1332	1154	1514	1252	-317	-419	-807	1430	1555	1196	25	-240	1502	1519	-195	110	84
224	770000	15	1538	1378	1375	1211	1578	1300	-350	-479	-881	1489	1625	1253	16	-294	1579	1586	-227	107	84
225	800000	13	1638	1488	1473	1311	1677	******	-552	-551	-931	1594	1796	1367	1	-302	1728	1719	-307	106	82
226	820000	13	1763	1593	1573	1424	1819	1465	-564	-635	-1654	1688	1865	1481	-24	-350	1860	1831	-374	101	3282
226	820000	13	1799	1634	1604	1452	1848	1483	-617	-661	-1731	1713	1889	1512	-25	-352	1921	1871	-389	99	81
226	820000	16	1804	1643	1610	1449	1851	1485	-631	-665	-1754	1714	1890	1515	-24	-352	1926	1877	-389	98	80
226	820000	15	1836	1664	1627	1468	1877	1490	-652	-687	-1804	1732	1910	1539	-25	-362	1968	1907	-403	97	80
227	850000	21	1923	1706	1703	1562	1970	1532	-760	-725	-1931	1779	2015	1654	-51	-437	2081	2016	-449	94	79
227	850000	13	1853	1706	1649	1507	1790	1449	-740	-694	-1895	1717	1960	1614	-37	-408	2019	1962	-425	92	79
227	850000	13	1773	1598	1564	1427	1710	1365	-726	-685	-1874	1674	1900	1565	-26	-383	1939	1902	-416	91	80
227	850000	12	1700	1528	1495	1354	1633	1300	-705	-677	-1863	1622	1840	1523	-15	-359	1864	1847	-396	91	75
228	550000	13	1588	1448	1403	1280	1542	1213	-715	-685	-1879	1574	1782	1485	-19	-347	1795	1796	-382	90	77
228	550000	8	1498	1384	1330	1222	1479	1148	-710	-680	-1874	1514	1717	1434	-14	-328	1716	1733	-363	79	70
229	540000	10	1472	1363	1305	1207	1458	1170	-722	-678	-1884	1501	1690	1411	-18	-328	1693	1716	-361	59	59
229A	540000	10	1472	1363	1299	1211	1459	1115	-722	-678	-1882	1501	1693	1421	-16	-327	1692	1715	-359	62	62
230	600000	10	1463	1368	1295	1213	1444	1105	-785	-724	-1946	1533	1730	1447	-45	-370	1739	1750	-403	52	53
231	660000	12	1462	1387	1305	1244	1436	1101	-835	-754	-2013	1582	1770	1482	-72	-412	1790	1792	-444	47	55
232	710000	16	1500	1426	1335	1302	1465	1119	-885	-780	-2067	1626	1807	1512	-99	-448	1834	1830	-482	43	57
233	608282	17	1616	1538	1452	1412	1498	1192	-933	-800	-2099	1726	1901	1602	-128	-493	1954	1927	-515	35	51
234	608585	16	1684	1610	1520	1473	1513	1234	-991	-830	-2148	1770	1937	1644	-133	-504	2004	1973	-514	34	53
235	608787	17	1786	1725	1613	1564	1538	1289	-1079	-884	-2240	1834	2002	1700	-137	-518	2077	2034	-535	26	48
236	609090	17	1890	1858	1725	1689	1567	1353	-1178	-931	-2344	1912	2109	1792	-161	-564	2084	2090	-553	26	49
237	609292	12	1996	1984	1844	1834	1626	1415	-1298	-987	-2409	1986	2238	1855	-164	-594	1834	1917	-592	17	43
238	609595	11	2134	2038	1871	2012	1675	1443	-1420	-1011	-2542	2029	2234	2031	-160	-674	1794	1799	-609	21	44
239	609696	12	2171	2068	1868	2031	1674	1455	-1446	-1004	-1866	2029	2211	1967	-219	-675	1889	1795	-606	20	43
239	609696	12	2191	2084	1861	2073	1678	1463	-1465	-1012	-1474	2048	2202	1940	-291	-677	1976	1802	-639	22	43
239	0	13	2198	2111	1856	2204	1681	1464	-1467	-1014	-1254	2054	2185	1940	-331	-679	2124	1842	-643	22	44
239	0	11	2210	2111	1857	2222	1679	1467	-1483	-1019	-1165	2044	2175	1937	-358	-683	2259	1852	-660	22	44
239	0	13	2211	2113	1845	2214	1684	1428	-1410	-1019	-1095	2042	2160	1923	-387	-682	2404	1837	-665	22	44
239	0	13	2225	2134	1853	2243	1688	1433	-1417	-1029	-1083	2046	2165	1924	-407	-690	2752	1835	-670	24	47

APPENDIX E - COMPUTER PPROGRAMME DESCRIPTION

E.1 PROGRAMME TO CALCULATE ACTIONS ON A REINFORCED CONCRETE SECTION

This programme is described in Sections 7.3.3 and 7.3.4.

The values of steel strain and concrete strain measured at any section defined a linear strain profile from which the strains at the top and bottom surface could be calculated for input into subroutines CONACT and STEEL which were used to compute the concrete and steel actions within the section.

E.2 SUBROUTINES CONACT AND STEEL

The following assumptions were made in deriving the subroutines:

(i) The strain profile was linear across the section.

(ii) When the neutral axis lay within the section, all concrete subject to tensile strain was assumed to carry no tensile stress once the maximum tensile strain in the concrete exceeded the fracture strain.

(iii) When strain across the section was tensile at all points in the section, all concrete subject to a strain greater than the fracture strain was assumed to carry no tension.

(iv) The stress-strain relationship for steel was tri-linear as defined by Figure E.1(a).

(v) The stress-strain curve for concrete in tension was linear up to a tensile fracture strain of e_{ct} at which the fracture stress was f'_c/Q (see Figure E.1(b)).

(vi) The stress-strain curve for concrete in compression was that proposed by Hogenstad et al.,[2] and shown in Figure E.1(c).

(vii) The section was, in general, that of a T-beam.

(viii) Moments were considered as acting about the mid-depth of the section where the net axial force was considered to act.

E.2.1 Subroutine STEEL

Section properties were known and the strain at the levels of top and bottom steel were calculated from the two known values of strain at the top and bottom surface. Stresses could therefore be found from the assumed stress-strain relationship.

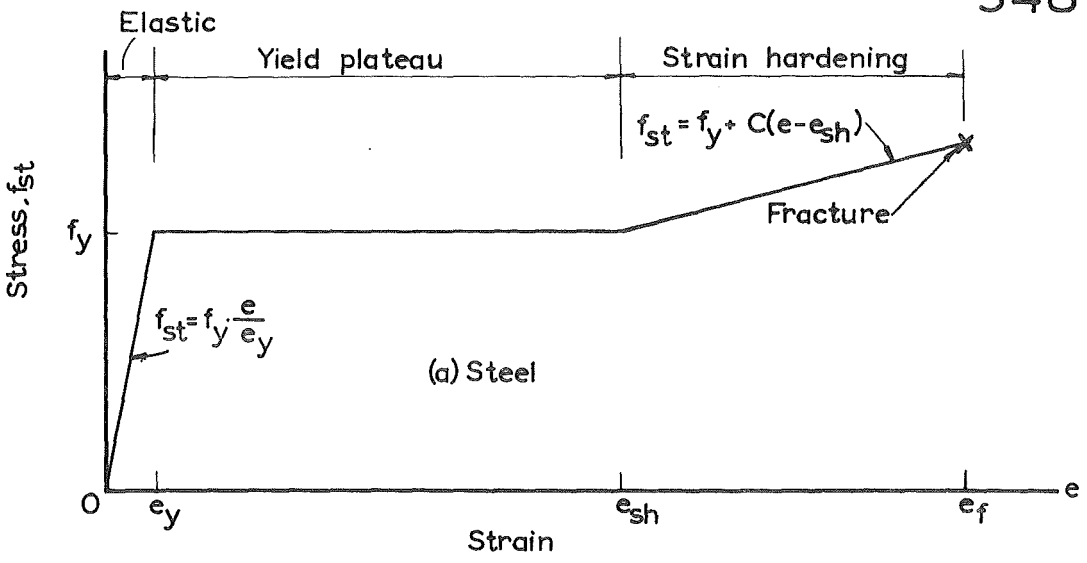
E.2.2 Subroutine CONACT

Knowledge of the top and bottom surface strains enabled the determination of concrete actions by use of the assumed stress-strain relationships for concrete in tension and compression.

Subroutine CONACT was written as four separate cases depending on the sign of top and bottom strains:

CASEA - Both top and bottom strains tensile

CASEB - Top strain compressive, bottom strain tensile



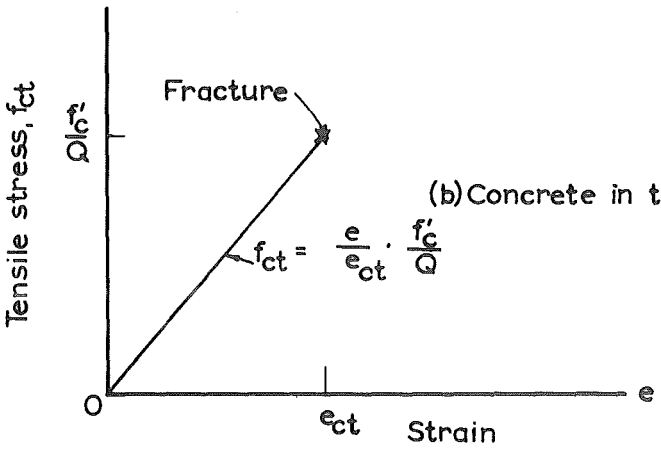
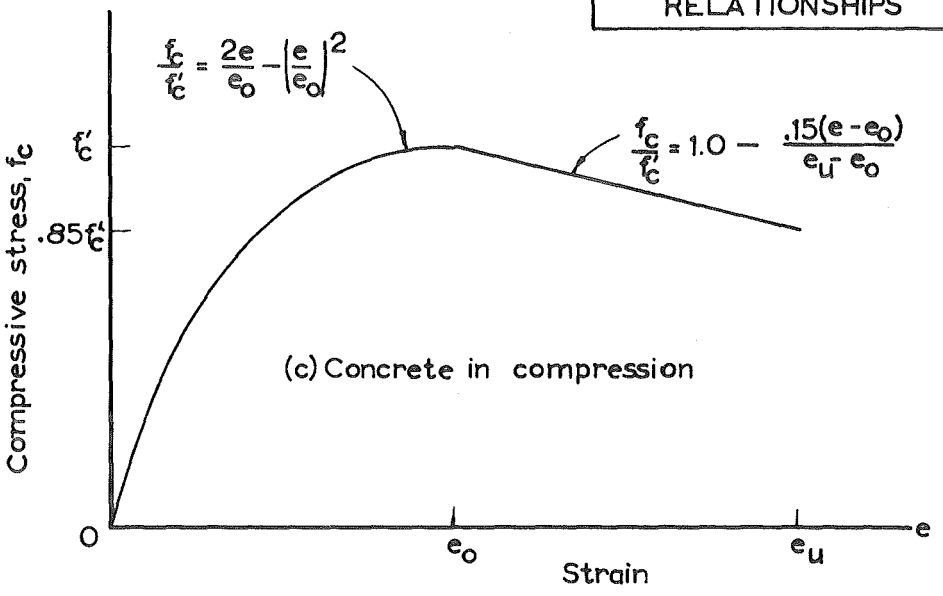


FIGURE E.1 ASSUMED STRESS-STRAIN RELATIONSHIPS



CASEC - Both top and bottom strains compressive

CASED - Top strain tensile, bottom strain comressive.

For each case integration of the stress-strain curve over the appropriate range of strains was performed analytically and the results used in the subroutines for the relevant case.

In computation the flange overhangs of T- or L-beams were ignored initially and the actions on the rectangular portion of the section were found.

To calculate the flange contributions, the strain at the level of the bottom of the flange was used in place of the strain at the bottom of the beam. The flange section was then considered as a rectangular section of different depth and breadth. The subroutines were then used to calculate the moment and force in the flange as related to its mid-depth which were transformed to equivalent actions at the mid-depth of the beam.

Values of the parameters defining the stress-strain curves used in computation were as follows (notation referring to Figure E.1):

f'_c = 4350 psf, f_y/f'_c = 9.78 (beam steel), = 11.82 (slab steel)

e_y = .0014 (beam steel) = .00169 (slab steel)

e_{ct} = .0028, Q = 1.85, e_o = .0028, e_u = .004

e_{sh} = .0100, e_f = .0101, C = 0.

APPENDIX F - RESULTS OF TESTS ON CONCRETE SLAB STRIPS

F.1 DESCRIPTION OF TABULATED RESULTS

The results of the tests on three slab strip specimens are tabulated below. The quantities listed are:

LSN = Load Stage Number

DVT = Vertical deflection at mid-span in .0001" units

DHZ = Horizontal movement of the free end in .0001" units.

CST = The average of the two concrete strains in microstrain. The values listed include a correction of -20 microstrain to account for initial loading.

SST = The average of the two steel strains in microstrain. The values listed have included a correction of +15 microstrain for initial load.

PRF = Total load, in pounds, applied to the strip through the proving ring.

NAPLD = The sum of the forces, in pounds, measured in the tie rods used to apply the axial compression to the section.

NCALC = Axial compression calculated from strain readings.

MAPLD = Total moment about mid-depth applied to the mid-span section.

MCALC = Moment calculated from strain readings.

Actions from the strain readings were computed using the subroutines CONACT and STEEL. The values of the parameters defining the stress-strain curves are given in the table and correspond to those given in Figure E.1. The variable, SR, is defined by

$$SR = f_y/f'_c = FY/FCDASH$$

SLAB STRP NC.1 JULY 1968

ECT= 0.800E-03 EC = 0.250E-02 EU = 0.650E-02 Q = 0.5000

EY= 0.169E-02 EH = 0.200E-01 FF = 0.100E-01 C = 0.0

SR = 11.400FCDASH = 4400.0

LSN	DVT	DHZ	CST	SST	PRF	NAPLD	NCALC	MAPLD	MCALC
1	0	0	-20	15	0.	0	101.	323	333.
2	0	-2	-44	0	0.	1007	1164.	323	350.
3	0	-11	-61	-24	0.	2019	2363.	323	370.
4	4	-19	-83	-40	0.	2995	3434.	324	422.
5	10	-25	-108	-52	0.	3993	4464.	326	541.
6	15	-29	-131	-73	0.	5005	5691.	330	552.
7	43	-25	-150	-55	50.	4987	5587.	619	937.
8	38	-20	-129	-40	50.	3999	4591.	613	888.
9	32	-12	-107	-23	50.	2999	3501.	607	849.
10	29	-8	-82	-4	50.	1915	2258.	603	801.
11	26	0	-58	13	50.	899	1124.	600	716.
12	20	5	-39	28	50.	34	199.	598	646.
13	43	2	-54	40	100.	32	235.	873	905.
14	50	0	-76	25	100.	1016	1235.	878	1005.
15	51	-5	-99	9	100.	2031	2291.	883	1099.
16	58	-8	-122	-7	100.	3035	3369.	890	1173.
17	62	-11	-144	-22	100.	4013	4371.	897	1241.
18	70	-19	-167	-40	100.	5011	5540.	908	1265.
19	92	-19	-182	-26	150.	5000	5464.	1193	1566.
20	90	-15	-162	-8	150.	3999	4410.	1183	1558.
21	85	-9	-141	6	150.	3015	3452.	1173	1490.
22	80	0	-119	24	150.	2003	2340.	1164	1440.
23	76	9	-97	41	150.	1012	1301.	1155	1358.
24	71	14	-75	57	150.	35	285.	1148	1266.
25	91	20	-88	71	200.	37	214.	1423	1519.
26	96	11	-109	53	200.	1032	1248.	1432	1586.
27	101	9	-133	39	200.	2029	2253.	1443	1712.
28	109	2	-154	22	200.	3017	3294.	1455	1768.
29	113	-2	-178	5	200.	4022	4405.	1468	1846.
30	120	-15	-202	-9	200.	5027	5440.	1483	1938.
31	142	-15	-219	-5	250.	5016	5431.	1769	2241.
32	139	-12	-198	20	250.	4034	4438.	1754	2187.
33	134	-8	-176	36	250.	3032	3422.	1738	2114.
34	130	2	-154	54	250.	2035	2338.	1724	2054.
35	126	11	-132	71	250.	1025	1318.	1710	1971.
36	120	20	-111	89	250.	32	290.	1698	1905.
37	145	25	-126	105	300.	35	222.	1973	2191.
38	156	20	-149	100	300.	1016	921.	1988	2387.
39	160	15	-171	83	300.	2037	1928.	2005	2472.
40	165	12	-194	66	300.	3035	2996.	2023	2554.
41	171	5	-216	49	300.	4023	4021.	2041	2626.
42	179	-5	-241	33	300.	5025	5107.	2062	2724.
43	200	-4	-258	45	350.	5012	5169.	2348	2996.
44	194	1	-235	61	350.	4030	4144.	2326	2914.
45	191	5	-216	78	350.	3037	3182.	2306	2877.
46	188	14	-194	96	350.	2036	2120.	2286	2814.
47	185	22	-172	120	350.	1011	916.	2266	2791.
48	180	30	-151	138	350.	45	-74.	2248	2721.
49	202	30	-166	154	400.	55	-167.	2524	3013.
50	209	26	-186	136	400.	1036	817.	2544	3065.
51	215	20	-210	120	400.	2062	1841.	2567	3174.
52	220	12	-232	103	400.	3046	2869.	2590	3246.

LSN	DVT	DHZ	CST	SST	PRF	NAPLD	NCALC	MAPLD	MCALC
53	225	4	-254	87	400.	4041	3851.	2613	3327.
54	235	-5	-281	72	400.	5042	4946.	2641	3454.
55	256	-4	-299	87	450.	5047	4934.	2927	3761.
56	251	3	-277	103	450.	4041	3954.	2899	3687.
57	250	10	-256	120	450.	3062	2954.	2874	3630.
58	241	19	-232	137	450.	2038	1902.	2847	3535.
59	240	25	-211	156	450.	1046	862.	2823	3486.
60	240	32	-192	180	450.	32	-241.	2799	3490.
61	4129	395	-105	2150	300.	55	-151.	1995	1771.
62	3940	396	-79	1840	200.	54	-190.	1444	1397.
63	3680	382	-53	1458	100.	56	-514.	893	1244.
64	3358	389	-26	1044	0.	58	-491.	342	800.
65	2812	399	-78	559	0.	1038	398.	614	919.
66	2640	371	-124	178	0.	2030	1143.	858	1047.
67	2630	270	-168	-332	0.	3023	1956.	936	1081.
68	700	-7	-176	-722	0.	4029	2320.	605	917.
69	419	-575	-195	-813	0.	5035	2574.	533	1004.
70	510	-555	-245	-739	150.	5023	3012.	1404	1410.
71	649	-538	-300	-569	300.	5061	3420.	2301	1901.
72	1065	-468	-361	-41	450.	5086	3615.	3339	2632.
73	430	-562	-198	-785	0.	4762	2584.	527	1042.
74	1678	-279	-36	346	0.	42	122.	330	476.
75	1679	-262	-30	830	0.	-42	-293.	315	708.
76	1290	-358	-69	325	0.	957	476.	446	716.
77	695	-485	-105	-297	0.	1976	1297.	460	632.
78	-482	-529	-137	-566	0.	2941	1816.	181	717.
79	421	-552	-163	-733	0.	3977	2108.	490	815.
80	391	-562	-189	-797	0.	4969	2503.	517	969.
81	423	-560	-659	-776	50.	4959	6838.	807	4183.
82	452	-558	-226	-754	100.	4951	2837.	1096	1264.
83	485	-552	-243	-728	150.	4947	2984.	1387	1402.
84	515	-549	-261	-698	200.	4945	3137.	1677	1549.
85	468	-545	-204	-690	100.	3967	2574.	1058	1141.
86	532	-525	-175	-525	100.	2983	2166.	1031	1022.
87	1018	-429	-143	109	100.	1930	1384.	1069	1149.
88	1641	-331	-106	716	100.	969	569.	1032	1220.
89	2385	-172	-63	1208	0.	-25	-229.	317	1177.
90	355	-621	-196	-811	0.	4970	2583.	499	1013.
91	478	-608	-264	-709	200.	4968	3175.	1660	1564.
92	511	-598	-237	-598	200.	3948	2831.	1624	1433.
93	951	-500	-213	2	200.	2964	2158.	1704	1603.
94	1679	-382	-181	672	200.	1953	1353.	1750	1753.
95	2429	-355	-135	1184	200.	921	520.	1646	1706.
96	3125	-198	-95	1678	200.	-3	-244.	1422	1689.
97	638	-658	-307	-524	300.	4969	3452.	2290	1976.
98	950	-588	-282	-69	300.	3929	2892.	2246	2059.
99	1653	-450	-251	581	300.	2944	2108.	2459	2210.
100	2755	-320	-217	1253	300.	1934	1285.	2505	2349.
101	3355	-248	-170	1723	300.	953	814.	2292	2010.
102	1030	-610	-351	-92	400.	4961	3558.	5033	2533.
103	1470	-521	-321	371	400.	4018	2936.	3113	2588.
104	2995	-342	-299	1274	400.	2932	2067.	3401	2950.
105	3512	-351	-255	1712	400.	1973	1658.	3215	2623.
106	4605	-242	-202	2239	400.	949	819.	2960	2491.
107	1419	-667	-380	159	450.	4936	3648.	3498	2878.
108	3602	-660	-384	1237	450.	3971	2900.	4228	3524.
109	4271	-615	-341	1776	450.	2941	2165.	4054	3484.
110	5038	-639	-290	2238	450.	1953	1678.	3781	3124.
111	4346	-590	-51	977	0.	4	-184.	324	953.
112	3959	-661	-100	622	0.	1000	576.	718	1121.
113	4138	-660	-117	898	50.	1042	576.	1029	1384.
114	4320	-651	-134	1069	100.	1095	594.	1346	1632.
115	4522	-646	-149	1279	150.	1145	592.	1665	1864.
116	4732	-635	-166	1482	200.	1194	614.	1988	2107.
117	4971	-622	-184	1709	250.	1239	1027.	2313	2055.
118	5197	-615	-202	1921	300.	1279	1051.	2637	2308.
119	5379	-609	-217	2097	350.	1305	1070.	2949	2518.
120	5655	-607	-234	2278	400.	1346	1133.	3284	2724.
121	6065	-626	-242	2312	397.	1415	1213.	3364	2780.
122	6400	-627	-244	2304	381.	1460	1238.	3354	2790.
123	6808	-572	-247	2293	370.	1490	1275.	3369	2806.
124	7309	-540	-248	2384	355.	1496	1270.	3370	2825.
125	8255	-588	-243	2141	302.	1418	1222.	3155	2788.
126	8912	-554	-234	2006	301.	1301	1233.	3135	2645.
127	9579	-755	-224	1761	287.	1130	1313.	2981	2432.
128	10366	-754	-201	1570	281.	881	897.	2783	2414.
129	11140	-754	-181	1399	296.	590	823.	2607	2170.
130	12508	-797	-149	1487	339.	123	440.	2340	1984.
131	13370	-890	-143	1462	347.	38	398.	2283	1925.
132	16000	-1221	-141	1314	356.	32	486.	2330	1825.

SLAB STRP NO.3 JULY 1968

ECT= 0.800E-03 EC = 0.250E-02 EU = 0.650E-02 Q = 0.5000
EY= 0.169E-02 EH = 0.200E-01 EF = 0.100E-01 C = 0.0
SR = 11.400FCDASH = 4400.0

LSN	DVT	DHZ	CST	SST	PRF	NAPLD	NCALC	MAPLD	MCALC
1	0	0	-20	15	0.	0	101.	323	333.
2	20	3	-35	29	50.	6	113.	598	600.
3	38	4	-49	41	100.	8	98.	873	856.
4	55	5	-64	54	150.	6	109.	1148	1122.
5	75	8	-77	69	200.	8	69.	1423	1403.
6	95	9	-94	80	250.	9	128.	1698	1652.
7	114	10	-110	95	300.	9	113.	1973	1941.
8	131	10	-123	109	350.	8	42.	2248	2193.
9	150	10	-140	123	400.	10	53.	2523	2489.
10	170	11	-157	137	450.	11	87.	2798	2778.
11	189	13	-173	156	500.	13	-54.	3073	3101.
12	209	16	-190	180	550.	16	-294.	3348	3471.
13	570	130	-610	1751	202.	66	2591.	1437	4105.
14	373	121	-331	1041	0.	40	1257.	324	2275.
15	51	85	-165	-129	0.	5020	8319.	348	284.
16	71	85	-186	-113	50.	5018	8330.	633	660.
17	94	83	-205	-94	100.	5016	8198.	920	1048.
18	115	83	-224	-79	150.	5016	8177.	1205	1397.
19	138	83	-247	-60	200.	5014	8118.	1492	1829.
20	158	83	-270	-39	250.	5012	8026.	1777	2272.
21	179	83	-298	-14	300.	5007	7945.	2062	2784.
22	200	83	-325	13	350.	5006	7884.	2348	3197.
23	225	76	-362	54	400.	5008	7882.	2635	3653.
24	251	75	-406	102	450.	5012	8031.	2923	4103.
25	285	78	-464	168	500.	5018	8320.	3216	4628.
26	321	80	-530	248	550.	5028	8677.	3509	5171.
27	368	81	-616	350	600.	5043	9264.	3808	5841.
28	419	85	-716	469	650.	5065	9992.	4110	6584.
29	470	90	-811	599	700.	5096	10550.	4412	7235.
30	70	50	-209	-126	0.	4992	9298.	357	745.
31	60	75	-184	-99	0.	4003	7822.	347	797.
32	81	79	-204	-78	50.	4003	7658.	630	1214.
33	101	80	-222	-60	100.	4004	7522.	913	1586.
34	124	81	-242	-40	150.	4008	7379.	1197	1995.
35	145	81	-265	-16	200.	4011	7209.	1481	2460.
36	170	83	-294	16	250.	4009	7062.	1766	2927.
37	199	86	-337	65	300.	4014	7074.	2052	3436.
38	226	89	-385	125	350.	4022	7193.	2339	3901.
39	265	90	-452	211	400.	4034	7490.	2629	4469.
40	308	95	-531	309	450.	4054	8014.	2922	5095.
41	359	100	-623	432	500.	4081	8595.	3219	5777.
42	409	105	-712	557	550.	4109	9142.	3516	6403.
43	470	114	-814	719	600.	4151	9645.	3818	7065.
44	61	73	-191	-98	0.	4008	7985.	347	868.
45	55	79	-166	-75	0.	3007	6638.	339	873.
46	76	80	-186	-55	50.	3003	6473.	620	1293.
47	100	80	-207	-31	100.	3005	6244.	903	1754.
48	121	81	-226	-7	150.	3010	5964.	1184	2313.
49	150	84	-253	18	200.	3013	5875.	1468	2810.
50	191	89	-320	122	250.	3024	5958.	1752	3353.
51	230	93	-415	241	300.	3047	6313.	2043	4067.
52	282	100	-509	372	350.	3079	6946.	2334	4762.

LSN	DVT	DHZ	CST	SST	PRF	NAPLD	NCALC	MAPLD	MCALC
53	348	109	-611	533	400.	3120	7525.	2631	5488.
54	408	116	-702	694	450.	3156	7941.	2926	6079.
55	470	121	-796	869	500.	3203	8345.	3223	6662.
56	56	80	-168	-73	0.	3011	6607.	339	919.
57	59	88	-153	-32	0.	1993	4945.	334	1211.
58	82	89	-184	4	50.	1998	4636.	614	1842.
59	116	90	-233	73	100.	2014	4494.	896	2423.
60	165	98	-318	202	150.	2035	4773.	1181	3127.
61	231	105	-419	374	200.	2077	5249.	1470	3861.
62	302	115	-520	565	250.	2125	5710.	1762	4541.
63	381	126	-622	771	300.	2179	6160.	2056	5198.
64	440	132	-695	933	350.	2216	6426.	2345	5640.
65	505	141	-780	1118	400.	2266	6766.	2637	6154.
66	68	89	-161	-24	0.	2006	4877.	336	1382.
67	105	100	-209	191	0.	993	2668.	333	1979.
68	183	112	-306	408	50.	1047	3024.	617	2629.
69	259	123	-391	610	100.	1099	3377.	901	3189.
70	335	135	-478	813	150.	1157	3781.	1186	3766.
71	406	145	-560	1010	200.	1204	4145.	1471	4298.
72	479	158	-645	1208	250.	1250	4536.	1757	4844.
73	548	163	-727	1399	300.	1294	4907.	2043	5362.
74	610	168	-804	1570	350.	1337	5272.	2329	5846.
75	692	170	-903	1766	400.	1397	5861.	2619	6433.
76	170	116	-266	267	0.	1063	3185.	341	2450.
77	340	159	-343	950	0.	44	1600.	324	2420.
78	431	171	-444	1203	50.	46	2096.	599	3112.
79	506	182	-526	1424	100.	49	2445.	875	3653.
80	589	192	-609	1661	150.	52	2753.	1151	4181.
81	702	202	-693	1943	200.	51	3133.	1426	4536.
82	840	221	-773	2216	250.	48	3502.	1702	4847.
83	1005	239	-859	2523	300.	45	3869.	1977	5159.
84	1200	255	-958	2836	350.	53	4339.	2254	5547.
85	1408	278	-1029	4900	368.	78	2836.	2359	4506.
86	1772	312	-1159	5350	390.	181	3374.	2497	4958.
87	2008	332	-1262	7000	386.	279	2585.	2504	4367.
88	2516	370	-1500	-6663	434.	525*******		2842*******	
89	3008	404	-1755	3020	462.	779	14275.	3099	8725.
90	3502	435	-2017	3020	476.	1026	16819.	3302	10234.
91	4012	462	-2297	3020	488.	1257	19404.	3513	11639.
92	4505	490	-2575	3020	509.	1449	21772.	3777	12793.
93	5000	512	-2863	3020	505.	1625	23970.	3912	13713.
94	5550	521	-3150	3020	495.	1791	25922.	4042	14399.
95	6010	529	-3389	3020	484.	1894	27393.	4120	14830.
96	6500	530	-3626	3020	481.	1979	28722.	4255	15153.
97	6750	529	-3749	3020	466.	2017	29368.	4245	15286.
98	7010	529	-3859	3020	463.	2046	29921.	4305	15387.
99	7275	529	-3962	3020	453.	2066	30420.	4315	15467.
100	7505	529	-4048	3020	436.	2079	30823.	4283	15525.
101	7755	529	-4139	3020	423.	2090	31234.	4267	15576.
102	8014	529	-4228	3020	413.	2089	31627.	4270	15619.
103	8120	529	-4275	3020	406.	2089	31828.	4254	15638.
104	8260	528	-4323	3020	408.	2078	32031.	4281	15655.
105	8489	528	-4395	3020	398.	2065	32327.	4265	15677.
106	9001	524	-4534	3020	373.	2016	32879.	4191	15707.
107	9490	524	-4655	3020	347.	1941	33343.	4074	15721.
108	10004	522	-4788	3020	333.	1832	33823.	3988	15724.
109	10529	522	-4922	3020	311.	1678	34289.	3799	15715.
110	11530	521	-5075	3020	300.	1313	34792.	3486	15692.
111	13499	521	-5091	3020	303.	374	34846.	2491	15689.
112	17460	520	-5911	3020	406.	17	36890.	2588	15425.
113	0	0	2630	3020	0.	-2115	1232.	323	-969.

LSN	DVT	DHZ	CST	SST	PRF	MAPLC	MCALC	MAPLC	MCALC
1	0	0	-20	15	0.	0	101.	323	333.
2	0	-5	-38	2	0.	998	934.	323	412.
3	5	-11	-60	-14	0.	1998	2010.	323	470.
4	8	-18	-80	-33	0.	2997	3114.	325	474.
5	13	-21	-105	-48	0.	4011	4234.	328	563.
6	19	-25	-127	-64	0.	5006	5319.	332	604.
7	40	-22	-144	-51	50.	4998	5332.	617	913.
8	69	-21	-159	-39	100.	4987	5316.	902	1195.
9	78	-20	-175	-26	150.	4983	5297.	1186	1495.
10	95	-18	-191	-14	200.	4979	5335.	1470	1775.
11	115	-15	-206	-3	250.	4974	5352.	1755	2038.
12	132	-12	-222	9	300.	4968	5375.	2038	2312.
13	150	-10	-238	22	350.	4966	5376.	2322	2589.
14	170	-9	-253	34	400.	4953	5381.	2607	2845.
15	29	-25	-135	-62	0.	4969	5456.	337	705.
16	15	-22	-112	-47	0.	4030	4403.	329	637.
17	35	-20	-126	-34	50.	4028	4331.	612	921.
18	52	-19	-140	-22	100.	4029	4288.	893	1195.
19	70	-15	-155	-11	150.	4022	4329.	1176	1458.
20	89	-12	-170	0	200.	4014	4350.	1458	1722.
21	105	-10	-186	13	250.	4012	4351.	1740	2004.
22	122	-8	-201	27	300.	4014	4303.	2021	2281.
23	140	-4	-216	39	350.	4018	4314.	2304	2537.
24	160	-1	-230	50	400.	4018	4351.	2587	2766.
25	20	-22	-112	-45	0.	4036	4316.	331	666.
26	13	-19	-92	-27	0.	3022	3250.	108	163.
27	35	-15	-108	-15	50.	3019	3265.	608	949.
28	52	-11	-121	-3	100.	3015	3225.	888	1202.
29	70	-10	-136	7	150.	3016	3283.	1169	1453.
30	89	-8	-151	19	200.	3015	3292.	1449	1716.
31	105	-4	-165	31	250.	3011	3304.	1729	1968.
32	122	-1	-180	44	300.	3009	3294.	2009	2222.
33	140	0	-195	57	350.	3011	3285.	2290	2485.
34	160	3	-209	69	400.	3009	3277.	2571	2729.
35	19	-15	-93	-27	0.	3023	3250.	328	672.
36	3	-11	-67	-12	0.	2027	2122.	324	564.
37	28	-10	-83	-1	50.	2028	2200.	603	838.
38	48	-7	-99	11	100.	2028	2236.	882	1116.
39	63	-4	-113	22	150.	2028	2251.	1160	1360.
40	80	0	-126	35	200.	2028	2190.	1439	1608.
41	100	1	-141	48	250.	2026	2187.	1718	1872.
42	118	3	-156	60	300.	2028	2211.	1996	2127.
43	135	8	-170	71	350.	2023	2260.	2275	2357.
44	152	12	-186	84	400.	2023	2286.	2553	2627.
45	10	-8	-69	-11	0.	2036	2121.	325	602.
46	0	-2	-46	6	0.	1015	1025.	323	530.
47	20	-1	-61	18	50.	1020	1049.	600	792.
48	40	0	-74	31	100.	1025	996.	877	10399.
49	60	3	-90	42	150.	1024	1081.	1154	1299.
50	76	8	-103	54	200.	1017	1081.	1430	1529.
51	95	10	-118	65	250.	1015	1138.	1707	1778.
52	112	12	-134	78	300.	1017	1170.	1984	2050.
53	130	16	-147	91	350.	1015	1119.	2261	2293.
54	149	20	-161	103	400.	1014	1121.	2538	2538.
55	6	-1	-46	7	0.	1026	998.	323	538.
56	0	0	-24	23	0.	27	-38.	323	446.
57	19	2	-39	35	50.	28	23.	598	699.
58	38	5	-53	47	100.	29	32.	873	948.
59	56	10	-68	59	150.	31	68.	1148	1206.
60	72	11	-84	70	200.	37	155.	1423	1466.
61	90	15	-98	83	250.	36	137.	1698	1721.
62	110	19	-113	95	300.	34	170.	1973	1977.
63	128	20	-126	108	350.	34	123.	2248	2221.
64	145	23	-141	120	400.	34	179.	2523	2469.
65	0	1	-25	25	0.	31	-61.	323	471.
66	22	-24	-134	-55	0.	5001	5197.	334	775.
67	98	-11	-194	-7	200.	4987	5161.	1471	1886.
68	170	-1	-256	43	400.	4975	5194.	2607	2954.
69	190	1	-273	56	450.	4964	5204.	2892	3240.
70	210	3	-287	69	500.	4958	5161.	3177	3490.
71	230	9	-303	81	550.	4952	5198.	3461	3748.
72	249	10	-320	95	600.	4949	5210.	3746	4030.
73	266	13	-335	107	650.	4943	5221.	4029	4277.
74	288	19	-352	120	700.	4937	5258.	4315	4548.
75	305	20	-368	134	750.	4932	5243.	4598	4818.
76	325	21	-384	148	800.	4928	5228.	4883	5087.
77	348	25	-404	164	850.	4924	5241.	5169	5411.
78	370	30	-424	187	900.	4920	5050.	5455	5797.
79	393	32	-451	225	950.	4917	4611.	5741	6371.
80	450	41	-510	396	950.	4940	1266.	5770	8361.
81	499	50	-538	540	950.	4942	4817.	5794	4160.
82	612	70	-578	863	967.	5016	4937.	5945	4606.
83	88	-12	-184	0	0.	4946	1873.	366	1390.
84	90	10	-75	242	0.	6	598.	323	714.
85	76	1	-64	258	0.	-45	474.	322	640.
86	55	-28	-139	15	0.	3914	1413.	344	1065.
87	98	-22	-174	46	100.	3902	1740.	911	1342.
88	116	-20	-190	52	150.	3896	1887.	1193	1469.
89	138	-19	-208	76	200.	3890	2055.	1476	1609.
90	160	-14	-228	103	250.	3888	2232.	1760	1770.
91	188	-10	-249	144	300.	3887	2407.	2046	1945.
92	216	-5	-269	194	350.	3890	2565.	2332	2117.
93	250	0	-292	260	400.	3898	2739.	2620	2319.
94	285	8	-316	336	450.	3905	2918.	2909	2529.
95	321	14	-340	401	500.	3916	3095.	3198	2739.
96	355	20	-362	466	550.	3923	3255.	3487	2929.
97	390	25	-386	528	600.	3928	3436.	3776	3131.
98	423	30	-409	598	650.	3936	3599.	4064	3329.

SLAB STRP NC.2 JULY 1968

FCT= 0.800E-03 EC = 0.250E-02 EU = 0.650E-02 D = 0.5000

EY= 0.169E-02 EP = 0.200E-01 EF = 0.100E-01 C = 0.0

SR = 11.400FCDASH = 4400.0

LSN	DVT	DHZ	CST	SST	PRF	MAPLC	MCALC	MAPLC	MCALC
99	460	38	-431	667	700.	3942	3753.	4354	3519.
100	493	43	-453	738	750.	3950	3903.	4642	3708.
101	540	51	-478	846	800.	3967	4053.	4937	3938.
102	676	76	-971	1169	839.	4051	7968.	5213	7151.
103	85	-20	-159	10	0.	3883	1617.	356	1211.
104	71	-20	-133	24	0.	2981	1346.	344	1026.
105	95	-17	-150	37	50.	2982	1505.	626	1161.
106	116	-15	-166	50	100.	2980	1652.	907	1290.
107	139	-11	-184	64	150.	2978	1812.	1189	1438.
108	163	-9	-204	124	200.	2979	1980.	1471	1607.
109	199	-2	-225	191	250.	2987	2138.	1757	1799.
110	241	2	-249	294	300.	2999	2305.	2045	2025.
111	285	11	-270	381	350.	3018	2438.	2334	2252.
112	332	21	-293	498	400.	3037	2582.	2623	2457.
113	380	30	-316	595	450.	3061	2725.	2914	2681.
114	429	39	-339	698	500.	3083	2869.	3205	2902.
115	472	48	-362	797	550.	3102	3014.	3494	3119.
116	520	55	-385	900	600.	3120	3155.	3785	3337.
117	570	65	-409	1016	650.	3138	3294.	4076	3569.
118	639	79	-431	1182	692.	3161	3377.	4320	3816.
119	89	-15	-135	39	0.	2980	1355.	349	1049.
120	78	-11	-108	62	0.	1938	1066.	338	860.
121	100	-10	-124	89	50.	1946	1208.	617	996.
122	129	-7	-143	141	100.	1954	1361.	898	1167.
123	171	1	-163	232	150.	1979	1495.	1181	1368.
124	220	10	-186	339	200.	1999	1646.	1466	1599.
125	273	20	-204	463	250.	2022	1733.	1753	1802.
126	328	30	-226	591	300.	2051	1856.	2040	2035.
127	375	40	-248	698	350.	2070	1993.	2225	2256.
128	428	50	-271	814	400.	2096	2132.	2612	2487.
129	478	59	-291	922	450.	2113	2247.	2899	2692.
130	529	70	-315	1050	500.	2141	2383.	3186	2935.
131	600	85	-339	1221	550.	2185	2487.	3479	3202.
132	100	-2	-107	102	0.	1980	1026.	342	876.
133	108	3	-86	196	0.	952	744.	333	771.
134	160	11	-105	327	50.	983	842.	613	990.
135	218	21	-121	457	100.	1010	909.	895	1184.
136	271	31	-136	589	150.	1039	964.	1176	1372.
137	328	41	-152	710	200.	1064	1036.	1457	1560.
138	381	51	-176	833	250.	1092	1186.	1739	1808.
139	440	65	-203	963	300.	1121	1359.	2022	2081.
140	490	73	-224	1089	350.	1147	1474.	2305	2306.
141	565	89	-243	1273	400.	1190	1526.	2590	2549.
142	165	19	-76	320	0.	1023	552.	339	767.
143	238	40	-44	628	0.	16	-1.	323	699.
144	282	46	-62	746	50.	26	98.	598	904.
145	340	56	-80	879	100.	29	185.	873	1117.
146	400	69	-101	1028	150.	37	290.	1149	1382.
147	460	80	-122	1184	200.	42	389.	1424	1609.
148	272	50	-36	719	0.	23	-150.	323	690.
149	96	-4	-75	103	0.	2016	700.	342	635.
150	150	2	-114	189	100.	2022	1034.	903	978.
151	243	20	-151	409	200.	2061	1246.	1473	1380.
152	370	45	-205	708	300.	2128	1565.	2051	1949.
153	490	66	-252	978	400.	2188	1828.	2630	2445.
154	550	78	-275	1116	450.	2215	1951.	2919	2689.
155	605	88	-300	1255	500.	2243	2090.	3208	2946.
156	673	102	-325	1398	550.	2275	2235.	3501	3213.
157	780	120	-358	1611	600.	2346	2383.	3805	3558.
158	901	148	-390	1829	650.	2425	2627.	4116	3824.
159	1065	178	-434	2082	700.	2534	3035.	4442	4125.
160	1128	196	-398	2216	650.	2015	2701.	4125	3879.
161	1551	270	-443	2444	694.	2351	3118.	4503	4186.
162	1681	285	-455	-1535	687.	2445	5579.	4513	2419.
163	2345	360	-515	-1531	700.	2890	6121.	4853	2822.
164	3602	480	-688	-1569	714.	3519	7624.	5517	3910.
165	4340	536	-820	-1545	692.	3808	8747.	5779	4726.
166	4350	538	-849	-1560	693.	3769	8993.	5445	4888.
167	4600	551	-878	-1532	638.	3861	9206.	5609	5073.
168	4801	569	-897	-1521	629.	3922	9349.	5665	5189.
169	5000	581	-914	-1508	620.	3979	9474.	5728	5294.
170	5250	602	-935	-1490	604.	4043	9626.	5768	5424.
171	5500	628	-956	-1466	581.	4101	9773.	5774	5557.
172	5752	650	-981	-1434	567.	4144	9943.	5825	5715.
173	6255	686	-1018	-3841	531.	4219	10413.	5884	5772.
174	6500	701	-1035	-1372	512.	4245	10309.	5896	6048.
175	6750	715	-1024	-1269	490.	4263	10151.	5892	6047.
176	7000	723	-1025	-960	470.	4275	9933.	5859	6229.
177	7259	736	-1028	-500	443.	4280	9621.	5868	6510.
178	7641	773	-669	-69	213.	3647	6408.	4282	4651.
179	8319	1761	-653	2021	257.	3414	4980.	4577	5559.
180	15451	858	-277	11630	333.	12	1552.	2174	3032.

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